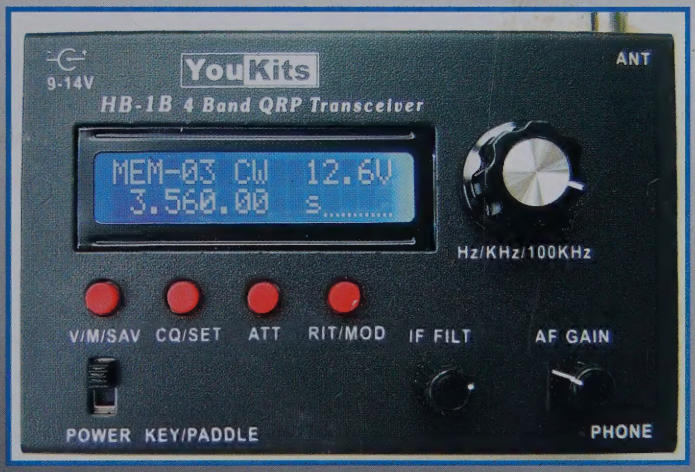
YOUR CONSTRUCTION AND OPERATING QRP SOURCEBOOK

QRP Quarterly

Volume 53 Number 1
Winter 2012

Journal of the QRP Amateur Radio Club International

IW9ARO Builds a 5-Tube SSB XCVR



N2EI Reviews the YouKits HB-1B 4-Band QRP Rig from TEN-TEC

- *FDIM Announcement!* Four Days in May 2012
- N6QW's DC Receiver Uses New Dual-Gate MOSFETs
- K7QO Shows How to Make Your Own PC Boards
- QRP Station in a Notebook by WB2QLL
- QRP Contests—
  - 2011 Fall QSO Party Results
  - 2012 Contest Schedule

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Kanga US – Watch for new items!

MicroR2 Receiver - $95
A 40m DC receiver. Can be modified for other bands. Extremely quiet. Boards and parts only – no case. Article in Oct 2006 QST

MicroT2 Transmitter - $95
a 40m phasing transmitter. Can be modified for other bands. VXO controlled (7.285 MHz xtal included). VXO capacitor included. 1 mw out. Board and parts only. Article in Dec. 2006 QST

6 or 2m CW source - $30
10mw CW sources for 6 or 2m. VXO Controlled (xtal included). Use small on-board trimmer or optional VXO cap for front panel control. Use as a signal source, home station TX, or rover TX.

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7 MHz IF – designed to work with the microR2 or any other 40 meter receiver you may have. The front end filter is about 300 Khz wide. A very effective way to get on 6 or 2 meters!

20,17,15,12,10m HF Converters - $36
7 MHz IF. Designed to work with the microR2 receiver or any other 40 meter receiver you may have.

UQRP TX MKII - $25
Any single band 80 – 10 meters. CW, VXO controlled (xtal included). Adjustable power output 0 – 5 watts.

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Also – AADE LC Meter ($99.95 kit, $125 assembled), TiCK Keyers, CW Touch Keyers

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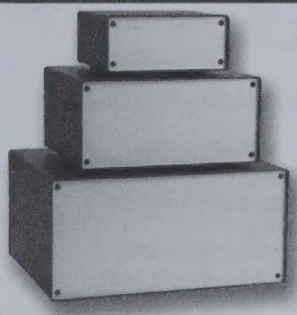
Enclosures for Projects



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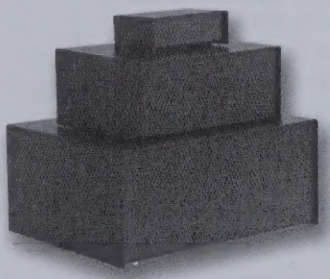
T-Series
The T-Series is our basic, low-cost, all-aluminum enclosure. The T-Series & the B-Series are available in a variety of standard sizes to meet your unique specifications.



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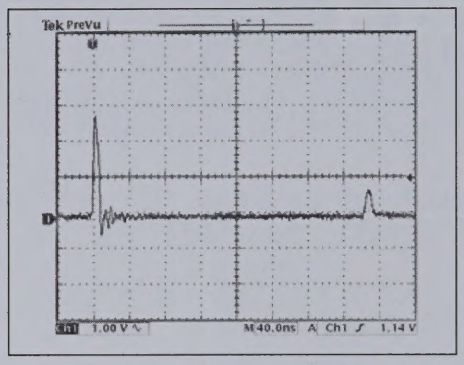

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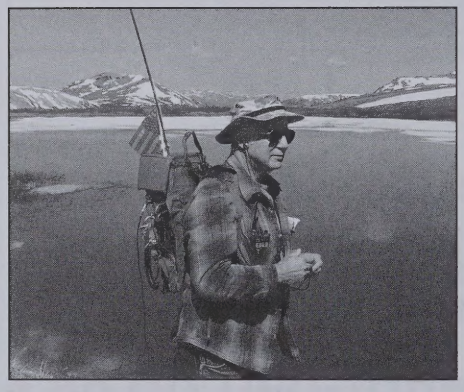

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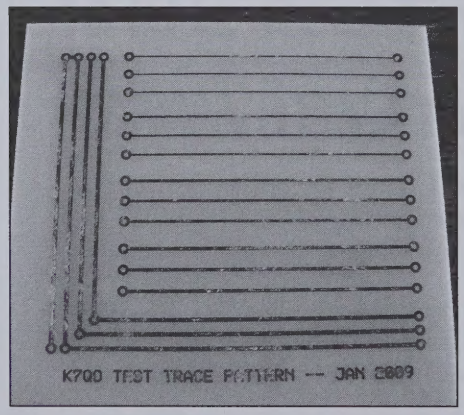

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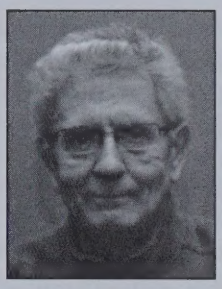


My greetings to you, the reader of this publication. When Ken Evans, W4DU, called me in August to see if I was interested in the position of editor, I was honored to be even be considered. I thought about his phone call for a couple days before accepting. I had never thought about me having such a position.

I thought you might be interested in my amateur radio background. I had always been interested but never had anybody around to help me get started. When I was doing postdoctoral research at the Boston University School of Medicine, I found a radio class. There, I learned code and theory. As a result, I passed the Novice exam and became WN1RJL. A couple months later, I was offered a teaching position at Indiana University Northwest and accepted. My call was shifted to WN9NLZ. From then I started what turned out to be a slow climb to Extra Class, thanks to teaching overloads.

I love to get a kit and build it. I have built several Heathkit and Elecraft amateur radio kits, among others, and did enjoy the experiences. I really can't wait to see what Heathkit will bring out in amateur radio gear, now that they are coming back. Now, with my new home built, and my "man-cave" complete, I want to get into building some of the projects I have seen published here.

Let me know what you think of this issue (my first) and any suggestions you might have. I know I am new at this position, but would love to hear comments from you. How about going to the website and telling us which articles you liked? This publication is for you and I want to be sure what you like gets published. With me writing this in advance, all I can say is that the website change is going to happen. If it hasn't, just drop me a line and tell me directly what you think. As you probably know, I have been the Clubhouse columnist for several years and would like to continue doing that, at least for the time being. Now that I am the Editor, I am looking for both articles you might have to write as well as club information. Write up that project you have been working on and send it to me. Please use those titles ("article;" "club") in your emails to me. Then I will know what you are sending me and can get the information in the right folder. Thank you!

In this issue (and I have mixed emotions about my first one), there are a couple new things Ten-Tec will be offering. Also, at the QRP forum at the Ft. Wayne (IN) hamfest, I saw how to make a three ring binder a QRP station. And there is much other stuff as well including Chuck Adams' article on pcb construction.

Lastly, I want to mention the QRP ARCI Accessibility Challenge. One of the positive aspects about amateur radio is that it is accessible to many regardless of physical abilities or disabilities. Our club has members that have many different disabilities, but it does not prevent them from engaging in our hobby. Many of us enjoy building. There is a thrill in using a piece of equipment made with your own hands. Many believe it possible that our members, individuals or clubs, could create a kit that could be built by our visually impaired members. This is the QRP ARCI Accessibility Challenge, which will be a special category in the FDIM 2012 building contest.

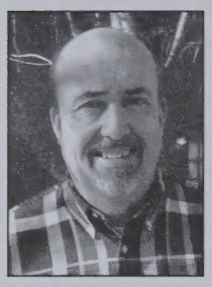
73 de WB9NLZ
Tim Stabler

On the Cover

This issue's highlights Giovanni, IW9ARO's 5-Tube SSB Transceiver (story on page 30), plus the YouKit QRP HB-1B transceiver, which is distributed by TEN-TEC. Skip, N2EI, has a review of this radio, which you can find on page 16.

From the President

Ken Evans—W4DU president@qrparci.org



Happy New Year! We start a new half century as we complete QRP ARCI's 50th or Golden Anniversary. The activation of the club call (K6JSS) in all fifty states was very successful. As I write this in mid December, 2011, we already have 8 amateurs that have worked all 50 states. Contacts have been made using all modes on all bands, proving QRP can be used for any mode available to the radio amateur. Plans are currently underway to use the club call in 2012 to highlight QRP activity. Stay tuned!

This issue sees the departure of Brian Murrey, KB9BVN as *QQ* Editor. Brian has served for over two years and consistently published an excellent magazine. I receive comments about the professional look and quality content of the *QQ*. It is because of the effort of people like Brian that the *QQ* can hold its own when compared with commercial publications. I thank Brian for setting a high standard. He will be missed. Our new editor is Tim Stabler, WB9NLZ. If the name sounds familiar, it's because Tim is the current editor of the "QRP Clubhouse" column. This is a very popular portion of the magazine and helps to make the *QQ* interesting to a wide segment of the hobby. I welcome Tim to his new role and am confident he will insure the *QQ* maintains its high standards.

Planning is underway for FDIM 2012. Preliminary information is available in this issue. You will also find a call for nominations to the QRP ARCI Hall of Fame. This is the highest honor the club can bestow and is your chance to recognize a notable QRPer. Finally, the terms for three members of the Board of Directors are expiring. Therefore, there is a call for nominations to the QRP ARCI Board of Directors.

—72, Ken Evans, W4DU
President, QRP ARCI

●●

QRP ARCI News

Call for Nominations to the QRP ARCI Board of Directors

The terms of three members of Board of Directors of QRP-ARCI will be completed on June 30, 2012. The three board members whose terms are expiring are Steve Fletcher, G4GXL; Ed Hare, W1RFI; and Bill Kelsey, N8ET.

This is an opportunity to step up and work for the club as a member of the Board of Directors. Even if the three members whose terms are expiring choose to throw their hat in the ring for re-election, now is the opportunity for YOU to step up and offer your services to the club.

The Board meets at least once every year at Dayton. However, most of the business is done over the Internet and all current BOD members will agree that the workload is not great. It is not essential that you get to Dayton for the meeting, though it is a great opportunity to join in at FDIM. It *is* essential that you have Internet access and beneficial, though not essential, to have broadband.

If you or are interested in running for election to the Board please send a brief resume to Ken Evans, W4DU at the email address below with a copy to Kathy Bromley, WQ5T. Nominations must be received by March 15, 2012. All nominations will be reviewed (per the QRP ARCI by-laws) and qualifying nominations published in the spring 2012 QRP Quarterly for a vote. Results will be published in the summer 2012 QRP Quarterly. The club by-laws state that any person nominated for election to the Board of Directors must have been an active member* of the club for the two years prior to nomination.

Ken Evans, W4DU, President
President@qrparci.org

Kathy Bromley, WQ5T, Vice President
vp@qrparci.org

*Active member definition from the bylaws: Active Member—participates whenever possible in Club functions, meetings, contests and other activities; subscribes to the *QRP Quarterly* magazine. Note—active members maintain voting rights by subscribing to the *QRP Quarterly*.

QRP Hall of Fame

The time has come for the call for nominations for election to the QRP-ARCI "QRP Hall of Fame."

You can submit either postal mail or Internet nominations via e-mail. All must include the following information.

Name & Call of person nominated
Name & Call of person making the nomination.

A full description of why you think your nominee should be in the QRP Hall of Fame (HOF) is needed. Remember the voting body may not know this person and you must convince them that the person is worthy. Things such as "John Doe is a great guy and always helps out at the club" will guarantee he is rejected. Be specific in your recommendation and try to persuade as to why your person should be in the HOF.

The voting body consists of the QRP ARCI Board of Directors, President, Vice-President and last eight members inducted into the Hall of Fame. Nominations may be submitted by anyone, whether a member of the QRP ARCI or not. Similarly,

membership in QRP ARCI is not required for someone to receive the honor, since this is an award to recognize those who have made great contributions to the QRP community, not just to the QRP ARCI.

If no nominations are received or the nominee(s) receive(s) less than the required 2/3 vote there will not be an induction at Dayton for 2012. The BOD is adamant that it is not a requirement that we will have an induction. A list of the current members of the HOF is included with this announcement.

Please forward your nominations to BOTH President of QRP ARCI (president@qrparci.org) AND to the Vice President (vp@qrparci.org). Mailed nominations should be sent directly to Kathy Bromley, WQ5T and Ken Evans, W4DU at the following addresses:

Ken Evans, W4DU
848 Valbrook Ct.
Lilburn, GA 30047
USA

Kathy Bromley, WQ5T
3424 Brooken Hill Drive
Fort Smith AR 72908-9254
USA

The closing date for nominations is March 1, 2012. When a nomination is received, a confirmation e-mail or letter will be sent to the person making the nomination. If you nominate someone and do not receive a confirmation, we did not receive it. You will need to receive a confirmation to insure your nominee will be considered.

—Ken Evans, W4DU, President: QRP ARCI
—Kathy Bromley, WQ5T, Vice-President: QRP ARCI

The QRP ARCI Accessibility Challenge at FDIM 2012

One of the positive aspects about amateur radio is that it is accessible to many regardless of physical abilities or disabilities. Our club has members that have many different disabilities, but it does not prevent them from engaging in our hobby. In an attempt to make things more accessible, the club has made the *QRP Quarterly* available in a screen readable format for our visually impaired members. This permits them to receive and read the *QQ* independently.

Many of us enjoy building. There is a thrill in using a piece of equipment made with your own hands. Many believe it possible that our members could create a kit that could be built by our visually impaired members. This is the QRP ARCI Accessibility Challenge. It will be a special category in the FDIM 2012 building contest. The goals and rules for this are as follows:

- Choose an equipment design that is a functional addition to the station. Obviously a XCVR would be great, but station accessories are good targets as well.
- The equipment would be offered as a kit that can be built by visually impaired/blind hams, but would be fun for sighted amateurs as well.
- The kit can be developed by an individual or a team.
- A completed kit (built by a visually impaired individual) and an unbuilt kit must be available at FDIM 2012 for evaluation.
- At least one member of the development team must be present at FDIM 2012 to answer questions from those evaluating the entry.
- Judging will be by a team of three judges (at least one must be visually impaired).

●●

Members QRP ARCI Hall of Fame (December 2011)

Chuck Adams, K5FO (1998)
Brice Anderson, W9PNE (1996)
Rich Arland, K7SZ (2002)
Dave Benson, NN1G (1999)
Harry Blomquist, K6JSS (2008) (silent key)
Fred Bonivita, K5QLF (2007) (silent key)
Michael Bryce, WB8VGE (2000)
Wayne Burdick, N6KR (1998)
George Burt, GM3OXX (1996)
Rick Campbell, KK7B (2009)
Jim Cates, WA6GER (1998)
L. B. Cebik, W4RNL (1999) (silent key)
Arnold (Arnie) Coro, CO2KK (2003)
Mike Czuhajewski, WA8MCQ (1997)
Tom Davis, K8IF (1996)
Doug DeMaw, W1FB (1992) (silent key)
Ken Evans, W4DU (2008)
Rev. George Dobbs, G3RJV (1992)
James Duffy, KK5MC (2007)
Joe Everhart, N2CX (2000)
Graham Firth, G3MFJ (2003)
Tony Fishpool, G4WIF (2003)
Dieter ("Diz") Gentzow, W8DIZ, (2005)
Paul Harden, NA5N (1999)
Rex Harper, W1REX (2010)
Wes Hayward, W7ZOI (1996)
Dave Ingram, K4TWJ (SK) (2010)
Doug Hendricks, KI6DS (1997)
George Heron, N2APB (2001)
Martin Jue, K5FLU (2009)
Bill Kelsey, N8ET (2004)
Ian Keyser, G3ROO (2004)
Hank Kohl, K8DD (2007) (silent key)
Jim Kortge, K8IQY (2002)
Roy Llewellyn, W7EL (1992)
Rick Littlefield, K1BQT (1996)
Tony Parks, KB9YIG (2009)
Dick Pascoe, GØBPS (1997)
Randy Rand, AA2U (1992)
C. F. Rockey, W9SCH (1996)
Eric Schwartz, WA6HHQ (2005)
Jim Stafford, W4QO (2010)
Hans Summers, GØUPL (2009)
Gus Taylor, G8PG (1998)
Steve Weber, KD1JV (2004)
Adrian Weiss, WØRSP (1996)
Peter Zenker, DL2FI (2001)

Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

Quickie Portable Operating Desk (#80)—*N2CX*
Elongated Loop vs. Flat Dipole—*KM2KM*
Measurement of Coaxial Cable Impedance—*NØKSF*
Alternatives to Grommet Strip for Coils—*GØNMD*
An Adjustable Low-Voltage AC Source—*KCØZNG*
More on the BNC Straightening Tool —*WA8MCQ, EB4APL*
Soldering Alligator Jumper Leads—*WA8MCQ, WC7S, WØEB, KCØPMH*
Reinforcing Anderson Power Pole Connectors—*W2SH*
Asymmetrical Power Attenuators—*WA8MCQ*

Quickie Portable Operating Desk (#80)

In the early '90s, Joe Everhart, N2CX, promised me an endless string of Technical Quickies for the column if I wanted to use them. Here is number 80:

Late in the summer of 2011 I renewed my interest in portable QRP operating. Inspired by frequent stories on the QRP-L online reflectors, I searched my local area for suitable venues. While there are lots of local parks, not all of them in the South Jersey area are ham-friendly. Seems the local park rangers have an aversion to anybody stringing up wires in existing trees, let along erecting an antenna support! Combining my daily walk with a decided liking for more secluded wooded areas I have located several nature trails that combine interesting surroundings with a scarcity of "official" observation—even within 5 miles or so of urbanity.

It became clear very quickly that "woodsy" operating had some challenges. Unlike Field Day or campsite operating, getting on the air trailside means carefully trimming the list of gear to take along to a very small total. Here's what I decided on:

- ATS-3B CW transceiver
- Extra band modules for the ATS (not often needed but I lose 'em if not kept with the rig)
- 9 to 10.5 volt battery
- American Morse Equipment Porta-Paddle
- Headphones (earbuds for ultimate portability)
- Antenna and coax cable
- Paper or small pad for taking notes and logging

A center fed dipole is usually the most effective antenna, but for quick setup and teardown in the woods it can get cumbersome. Fortunately one of my portable operating icons, Jim, W1PID, found that a 30 foot end fed wire can be easily matched on 20 meters with an Elecraft T-1 Tuner. It's nearly a half wave on 20 so it is both efficient and effective if erected vertically. Thus the antenna components in the above list are a 30 foot wire, a T-1 Tuner, a short coax cable, 60 feet or so of twine and a two ounce lead fishing sinker to throw over a handy elevated tree branch.

I highly recommend that you paint the sinker bright yellow or some other very visible color to make it easy to find when it inevitably gets hung up in a tree or falls into a tangled pile of brush.

When I began my sylvan adventures I simply carried all of the above in a backpack, suitably protecting each piece with bubble wrap or enclosing them in zip-lock plastic bags. But when I actually set up the equipment to operate, I found it very inconvenient to hold all that stuff in my lap or laying around loose. Worst of all, holding the two-handed paddle, operation and logging was awkward. What was needed was some sort of portable operating desk.

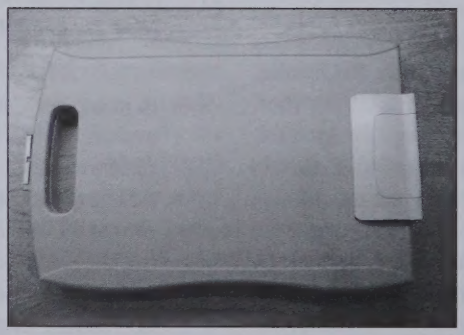


Figure 1—Storage clipboard.

I recalled that several years back I used a storage clipboard to hold a NUE-PSK modem, a small keyboard and some interconnecting cables in conjunction with an FT-817 slung over my shoulder with a leather strap. This, along with a handy tuned whip antenna gave me a pedestrian-portable PSK station to geek it up at the Dayton Hamvention. The storage clipboard, available at most office supply stores, is shown in Figure 1.

It's roughly 10" x 14", has a built-in carry handle, an external clip to hold papers and a flip-open lid revealing an internal storage area for papers, pens, etc. For the portable PSK station I used double sided adhesive tape to hold the NUE-PSK modem and keyboard inside. To use it I simply flipped it open and connected the modem to my FT-817.

Visualizing the size of the portable setup described above, I figured that all of it would fit inside one of the cases. Rather than trying to use the equipment while inside the case I could use the case to carry all of the pieces. The case itself could then be used as a laptop portable desk with the gear set up on its upper surface and paper for logging held in place by the external clip.

Figure 2 is a photo of the equipment laid out on top of the case. Not visible in the photo is a piece of non-skid shelf liner placed on the operating surface to prevent the pieces from sliding off at inopportune moments. Some steno-pad sized paper is held by the clip on the right hand side for note taking and logging. For simplicity the antenna and coax cable are not shown. This is a very convenient setup good for use while sitting on a log or rock, on the ground or even when operating inside a camping cabin or car when rain dictates against outdoor activities.

Carrying the portable station pieces loose inside the storage case is not a good idea. Surely they will be at least banged up cosmetically and at worst damaged. There is not enough room inside the case to individually wrap each piece in bubble wrap

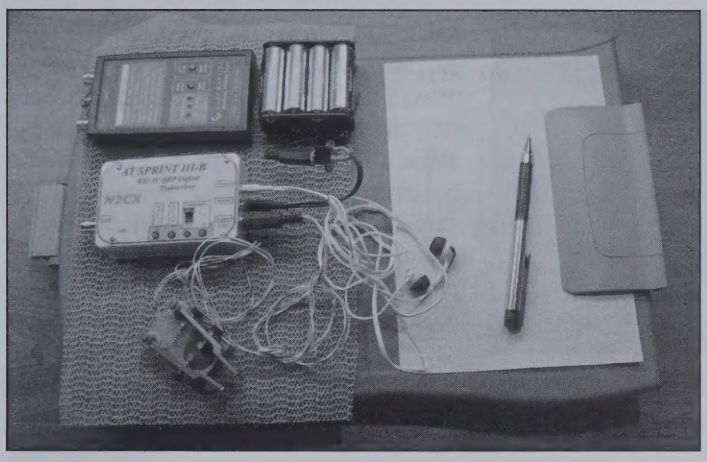


Figure 2—Equipment set up on the portable desk.

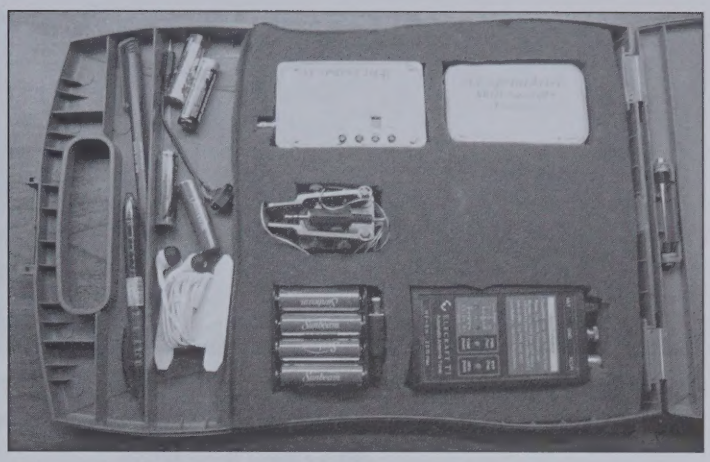


Figure 4—Equipment installed in carry case.

and this is overkill anyway. What I decided to do was to line the inside of the case with a flexible foam material and make cutouts for each item. The foam holds them firmly in place to protect them.

I also put the non-skid shelf liner and log sheets over top of the foam to keep the upper surface of the gear from banging against the case top. Suitable flexible foam about an inch thick can be purchased from an upholstery shop. In fact, since you only need a piece about a foot square you might find a scrap piece that the proprietor will give you for the asking.

Cutting the foam to size is easy. I recommend that you first cut it to so that it fits in the case, leaving about two inches at one end for storing pencils spare batteries and other loose items. If your case is tapered in thickness as mine was, you'll have to shave some of the bottom of the foam piece to taper it for a good fit inside. If it's too thick, the case lid will bulge and not fit properly. A sharp sheetrock knife and some elbow grease will do the trick.

Next, get ready to cut out the holes in the foam for each piece of gear. I found it easiest to visualize where each piece would go by making paper template for each and rearranging them on the foam surface for best fit. When deciding on the template shapes remember that the paddle and battery pack have attached cables that require a little extra room. Figure 3 shows the templates in place for my setup. You may note that there is an open spot in the foam liner for some future piece of gear.

Once the best layout has been done, simply glue the templates in the appropriate location with rubber cement, white paper glue or contact cement. It's best to cut the foam liner while it is inside the case to keep it somewhat rigid. However, it is a good precaution to slip a thin piece of cardboard underneath so you don't accidentally cut through the case. When the glue has dried, simply cut around the templates all the way through the foam liner. I find it best to cut each hole a little undersized so that the equipment fits snugly in its location. While the sheetrock knife used earlier will work here, I found that a single-edged razor blade or Xacto™ hobby knife gives more precise cuts.

Finally, remove the equipment from the foam liner and set it aside and remove the cardboard from the case. For best fit I recommend now gluing the foam liner in place in the case using good contact cement. When this glue has dried you can then fit all your gear in place as shown in Figure 4. Note the extra room at the end for ancillary items. While I've shown the extra stuff loose it's really a good idea to use rubber bands or small plastic bags so they don't bang around too much during transit.

Now a word about batteries. The ATS-3B will work over a voltage range of 5.5 to 12V with highest output power and current drain at the high end of the range.

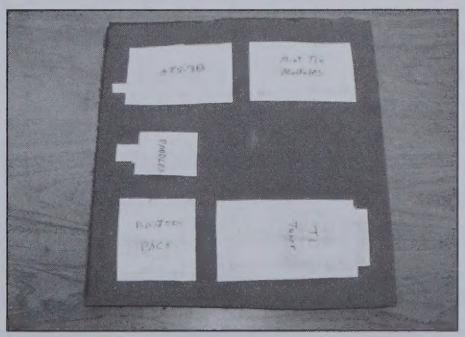


Figure 3—Templates on foam liner.

Operating it with more than 12V can (will) cause damage. I usually use a battery holder that will accept 8 AA sized cells. With NiCd or NiMh rechargeables the nominal output is in the area of 9.6V, a good value. With alkaline AA cells the voltage with a fresh set is slightly over 12V.

Being conservative, I use only 7 cells for about 10.5V. I use a "dummy cell" to fill the eight slots. This dummy is a piece of 1/2" wooden dowel cut slightly shorter than a standard AA cell. Two "dots" of copper clad pc board are glued onto each end to form contacts and to bring the total length to that of an AA cell. A hole is drilled through each end piece and the dowel from end to end, and a piece of hookup wire is soldered to the end pieces to form a short circuited cell.

As already mentioned, antennas are a challenge for portable operation, particularly for quick setup and teardown. The 20 meter 30 footer is convenient although too large to fit inside the portable desk/carrying case. A couple of times I did try something small enough. It was a spool of dental floss tape—don't laugh, that stuff is tough—and some 24 gauge magnet wire. While it did work, it was too flimsy and tended to get tangled in every twig and branch in a 50 foot radius.

The practical answer is to use a separate container for just the antenna. My favorite is a cloth drawstring bag the size of a gallon plastic food bag bought at REI (a national chain that sells camping and outdoors equipment and clothing). It's light, rugged and even looks like something a hiker might carry!

Freed from size constraints, I use a 30 foot piece of stranded hookup wire with

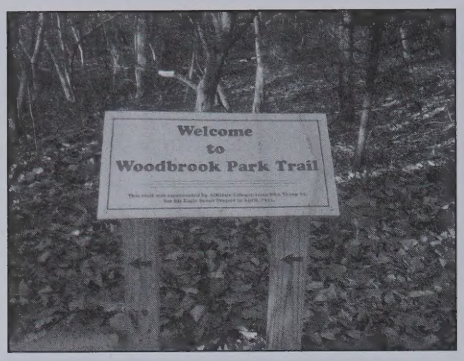


Figure 5—Woodside Park marker.

Figure 6—Favorite trailside operating location.

slick Teflon insulation for the radiator and nylon mason's twine for the hoisting line. A two ounce fishing weight is slipped inside a yellow tennis ball through a small slit. The tennis ball is easier to throw than the bare weight and hurts less when it comes hurtling back at the thrower. As a backup and for multiband use I also sometimes throw a lightweight dipole in the carry bag.

Finally, a word or two about my current favorite hiking and operating spot. The serendipity began when I found a paperback history of a local township written by a librarian. She mentioned that a local Eagle Scout had refurbished a dingy park into a park with marked, cleared trails and rustic trailside benches. I was surprised since I knew that the area had been nearly abandoned since a bowling alley had closed and was torn down on the property 40 years ago. With my interest piqued I checked it out and found a fully wooded area with several half mile trails and only a few signs of its previous purpose.

Figure 5 is the sign that greets visitors when they enter the park and Figure 6 shows a clearing with one of the best operating location in the woods. Sitting here writing about it, I can almost hear birds twittering in the trees, wind whispering through the area and a variety of fauna rustling in the underbrush—oh yeah, and several QSOs on 14.060!

—DE N2CX

Elongated Loop vs. Flat Dipole

Sent in by Kris Merschrod, KM2KM (ex KA2OIG)—

Gary (K9AY) Breed's article (Ref 1) was just what I needed to start off my 30 meter 2011/12 project. I'd tried to work all states from various countries over the years, but I never quite made it. This Fall I decided to do some antenna farming for 30 Meters. The antenna farm includes a tall spruce, and it would be possible to climb up to the 64 foot level to hang the elongated loop described.

I'm a convinced Quad-nut (Ref. 2) and have one for 40 meters and another for 17 meters, but, then again, EZNEC is always handy to replicate and compare. The logical alternative would be a dipole even though the second tree to support it would only allow a 50' height at the center—about a half-wave length. A dipole would be much easier to hang because with a casting rod the lines could be fished through the trees and I would not have climb all over the tree.

Table 1 compares the two models showing a very slight, but probably not significant, advantage with the elongated quad. My conclusion was to go with the dipole. The actual SWR is posted. (The modeling assumptions are not always solid. Plus there are a couple of lengths of coax in between.)

Ref 1: Breed, G., 2011. Antennas 101: The Elongated Loop. *QRP Quarterly*, Vol. 52 No. 3, p. 40-41

Ref 2: Merschrod, K. 1989. Coil Shortened Quads - A Half Size Example on 40 Meters. *Antenna Compendium Vol. 2*, ARRL.

—DE KM2KM

Take Off Angle, Degrees	Quad gain, dBi	Dipole gain, dBi
15	6.19	5.55
20	7.42	6.94
25	7.78	7.52
30	7.51	7.47
SWR 10.100 - 10.150 MHz:	1.17 to 1.1	1.39 to 1.34 (1.6 to 1.5 Actual)
Assumptions		
Ground Type:	Real/Mininec	
Ground Description:	Medium (0.005, 13)	
Wire Loss:	Copper	
Height (feet):	64 and 29.56	50

Table 1—Comparison of the Elongated Quad with a Dipole.

Measurement of Coaxial Cable Impedance

Submitted by Jack Boswell, NØKSF—

I had a opportunity recently to acquire some small Teflon coated cable. It had no markings on it to tell what kind of cable it was or the impedance. So, did you ever wonder what the impedance of that piece of unknown coax cable was? Well I did, so I started looking on the internet and found some of the information on this site.

http://www.irb.hr/users/stipcevi/ele/coaxweb/index.html

This started me thinking about some technical manuals that I had from IBM using the 453 Tektronics scope. We were able to determine failures in coax cable and twisted pairs on main frame computers. Most of this information was used to determine if the cable was shorted or not terminated properly. It also would measure the length of that cable.

Here are the instructions and calculations from the website that I used to test my project. (Author Mario Stipcevic gave permission to use some of his figures.):

1) Take a long piece of cable, usually 9-100 feet, the longer the better.

2) Connect one end of the cable to the 10 nanosecond pulse circuit of any fre-

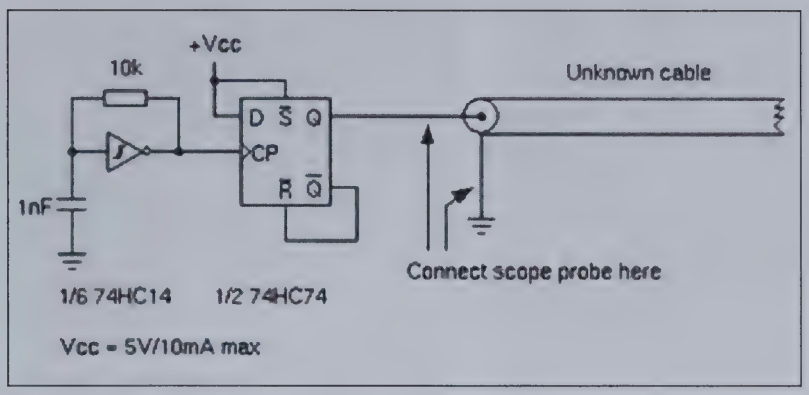


Figure 7—Pulser and connection diagram. (Figures 7, 8 and 9 are from the web site.).

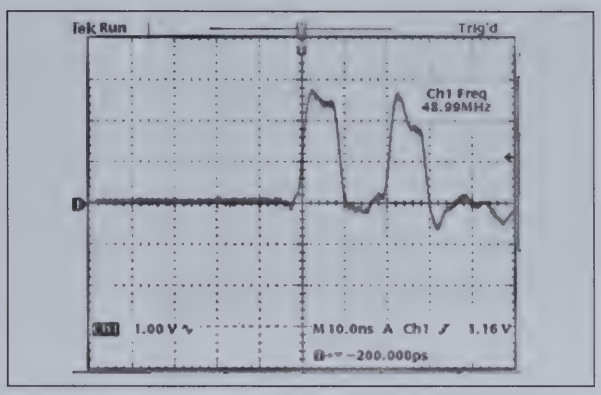


Figure 8—Original and reflected pulses for a 2 meter long coax cable..

quency. One can use a pulse circuit shown in Figure 7. Leave the other end of the cable open.

This is where I strayed from the instructions...

A lot of us have good oscilloscopes. You really only need a single channel scope that will get down into the nanoseconds. I have a 453 Tektronix scope but it has issues (another project not finished). I also have a 2445 Tektronix scope with a lot of the same features and more. In the IBM manual it used the B Gate output to generate our pulse for testing. If you do not have a scope that will generate a pulse, build the circuit in Fig. 7.

3) I used the B Gate output on the back of the oscilloscope to generate my signal. I connected the cable under test to the B Gate. You measure the signal at the driving end with a single channel scope. Use Figure 7 to connect your scope to the unknown coax. There will be two pulses separated by a time lapse required for the pulse to travel down the cable and back. Measure that time lapse and divide by two to get the time ΔT (in nanoseconds) that takes the pulse to travel down the cable (see Figure 8, the author's original picture).

4) Measure the capacitance of that particular piece of cable, C (in pF).

Now, the impedance of the cable is given by:

$$Z = 1000 * \Delta T / C$$

where:

Z = impedance in ohms

ΔT = one way travel time in nanoseconds through the cable (that is why you divide the time lapse between the leading edge of the pulse from Gate B to the next blip on the scope, the reflected edge)

C = capacitance of the cable in pF

The formula is simple and you don't need to know the length of the cable, you only need to access one end of it.

Equipment needed:

- One channel scope.
- Capacitance meter
- Pulse generator

These are the results of the author's testing from the website.

Measuring a coaxial cable 2 meter long of RG 58 A/U gives 52.6 ohms, good enough for such a short cable.

Measurement of a coaxial cable 29 meters long of RG174 50 ohm cable (see Fig. 9) gives a ΔT = 153 ns, C = 3.10 nF => Z = 49.4 ohms. Note that the pulses are separated by 306 ns, from which I have calculated ΔT = 306 ns/2 = 153 ns. Note also that longer cable will yield a smaller reflected pulse.

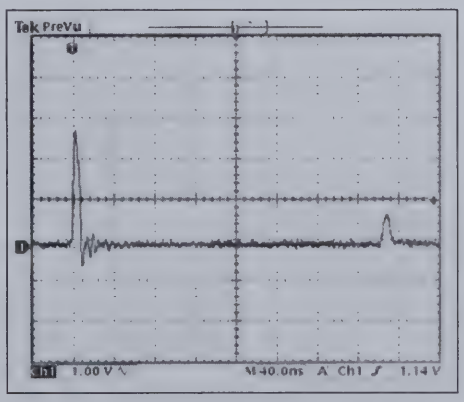


Figure 9—Original and reflected pulses for a 29 meter long coax cable.

NOTE 1—The author says that this formula might work only for coaxial cables. But I would think that it would work with other twisted wires.

NOTE 2—This is the long version of how we get to derive the formula that the author used:

$$Z = 1000 * \Delta T / C$$

$$n = c/v = \Delta T/L = \sqrt{(\varepsilon_r * \mu_r)}$$

where n = refraction index, v = speed of EM waves in the isolator. $\mu_r = 1$ because we do not have magnetic medium.

$$\text{cylindrical_capacitor_capacitance} = 2 * \pi * \varepsilon_0 * \varepsilon_r * L / \ln(D/d)$$

ε_0 = 8.8542E–12 farad/meter, vacuum dielectric constant

Z = 138 * log(D/d) / sqrt(epsilon_r) = 59.93* ln(D/d)/n, a formula from the book published by Howard W. Sams & Co. 1975, page 24-21.

The following is some of the testing that I performed:

I added a short piece of cable with BNC connectors on the back of my 2445 Tektronics scope (so I could get it out front for convenience of connections). I added a BNC tee connector to the short piece of coax coming from the Gate B output. I connected one side of the tee to the cable under test using a connector that has a BNC on one side and terminals on the other. I connected my scope to the opposite side of the tee and measured the time lapse between the two pulses.

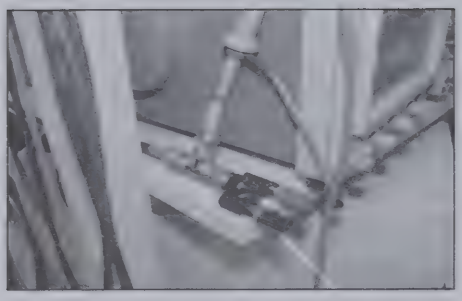


Figure 10—A cable to the B Gate connector on the rear goes to a BNC tee, where the probe and unknown cable are connected.

Figure 11—Results of the unknown Teflon cable.

I measured 45.5 nanoseconds dividing by two to calculate the ΔT. This would give us 22.75 nanoseconds to substitute into our formula. I took my capacitance meter and measured the capacitance at 422.2 pF.

$Z = \Delta T / C$

So 45.5 ns is divided 2 then the results 22.75 ns divided by 422.2 pF = 53.88 ohms. Figure 10 is a shot of the setup and Figure 11 is the measured waveform.

Note: The first line is the start of the pulse going down the test coax and the second vertical line is the reflected pulse and this is where the measurement is taken and where you get the ΔT = 45.5 nanoseconds.

I measured a piece of RG-58 and here are the results:

154.3 ns divided 2 = 77.15 ns divided by 1580 pF = 48.829114 ohms

I also measured a piece of 91 ohm cable:

36.5 ns divided by 2 = 18.25 ns divide by 187.3 pF = 97.43 ohms

This was a fun experiment. I hope this will be helpful to you.

—DE NØKSF

Alternatives to Grommet Strip for Coils

From Les Austin, GØNMD—

This is regarding your column in the Fall 2011 issue. Phil Salas's stuff on coil-making is brilliant, and I used his ideas some time ago to make a coil for a portable vertical aerial similar to the one on his website. But noting the request in the Fall 2011 *QQ* for a wider spacer for coil-making brings to mind Phil's own instruction to "think outside the box" when looking at things unconnected with ham radio.

I had to make my own spacer for the coil because I could not find anything suitable, although grommet strip is sold in the UK by Radio Spares, among others. It is worth trying a ships chandler, as it is often used on boats for protecting pipework and wires through bulkheads.

We were having a new section built onto one of the churches where I work, and the construction was mainly a timber frame. The carpenters were using nail-guns and the nails come on a plastic strip. I picked up three strips after they had done their job. The form is ideal for coil-winding guides, and the spacing is about 3.5 to the inch (10 mm pitch). It may well be that different sizes of nail-strips exist. Figure 12 shows two pictures of these strips.

There will be other stuff around that has different pitch-spacing, too. Look around with an open mind and you will find something that fits the bill. The skill is to see it before you need it, not after. I am working on that one!

—DE GØNMD

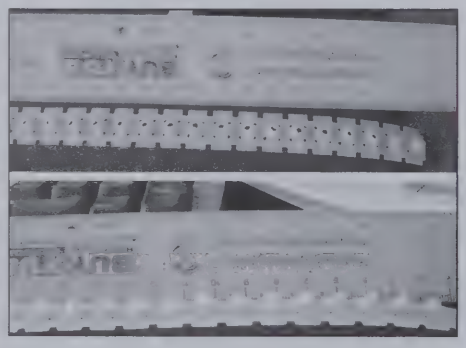


Figure 12—Carrier strips from nail-gun nails are an alternative to grommet strip for making air wound coils.

An Adjustable Low-Voltage AC Source

Submitted by Bryant Julstrom, KCØZNG—

A standard item on the bench of every experimenter and builder is an adjustable, metered, low-voltage DC power supply. Almost as useful, but far less common, is an adjustable, low-voltage AC source.

A simple AC source is easy to build but requires a small variable autotransformer---frequently called a Variac—to provide the adjustability. All that's necessary in addition is a low-voltage transformer, an AC voltmeter, a suitable enclosure, and some hardware. Figure 13 shows an appropriate circuit.

Construction is straightforward. The enclosure must accommodate the transformer, meter, switch, and connectors, but nothing about the parts placement is critical. Design the front panel to suit your needs, and work from there.

The transformer I used has nominal output of 16V, and the voltmeter's range is 0-20V. The enclosure was bent up from aluminum sheet (make the big hole for the meter before bending) and painted with spray enamel. Two sheet metal screws attach the upper half to brackets on the lower half. The few labels were made with a Brother label maker on black-on-clear tape. Figure 14 shows the finished unit.

Variable autotransformers are available through a number of mail-order outlets and frequently appear at hamfests. The one I use was assembled by my friend WØHE. Its maximum output is 145V, so the unit's maximum output is (145/120) x 16 = 19.3V.

An adjustable AC source like this has many uses. For example, it can:

- Provide input voltages for experiments with DC power supplies and regulators.
- Provide filament voltages for circuits that use tubes, without tying up a DC supply. It's particularly handy for less-

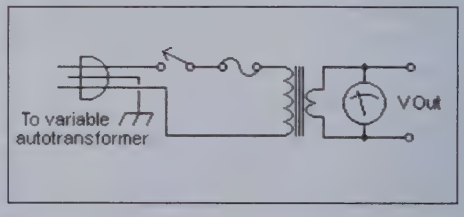


Figure 13—Circuit of the adjustable low-voltage AC source. Note that it plugs into a variable autotransformer.

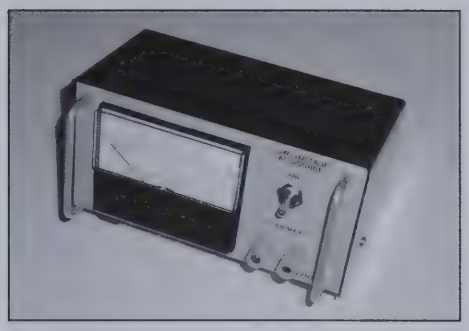


Figure 14—The completed AC source.

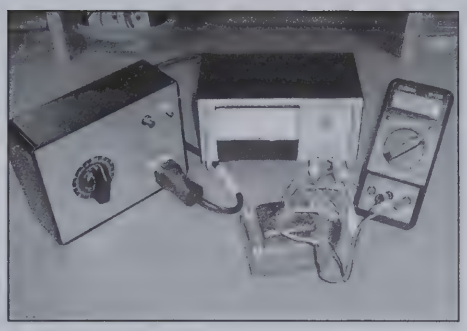


Figure 15—Measuring the output voltage of a power transformer's HV winding. From the left, a variable autotransformer, the low-voltage AC source and the transformer under test, and a digital multimeter.

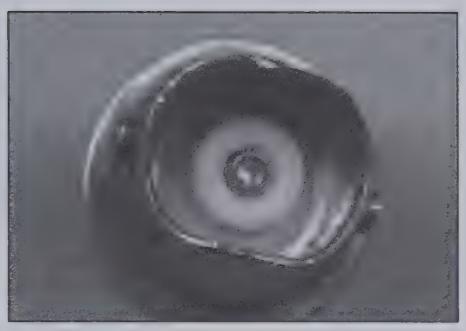


Figure 16—This BNC is smashed in enough that it cannot be mated; I did this myself for demo purposes, but I've seen much worse in the real world.

common filament voltages like 8V and 11V.

- Test unknown power transformers, especially high-voltage ones, easily and safely. Apply 12 VAC to a transformer's primary winding, and the secondary voltages will all be one-tenth of their nominal values.
- Identify the operating voltages of components like relays and indicators. Increase the voltage until they operate; now you know.
- Determine the pinouts of mystery LCD displays. These require 5 VAC to show up.

The unit requires a variable autotransformer, which can by itself provide low AC voltages, but there are several reasons to prefer a Variac and a unit like this to a Variac alone:

- A Variac alone introduces the possibility of high AC voltages on the bench.
- By including metering, the low-voltage source makes it easier and safer to monitor the output voltage. There are fewer test and clip leads on the bench.
- The low-voltage source makes fine adjustments of voltage easier; it acts as a vernier on the Variac control.

[*WA8MCQ comments:* Assume you want to change the low voltage AC output by 2 volts. Since the Variac covers a range of 0 to 145 volts, a 2 volt change on the Variac output takes a very small movement of the knob. But when using a 16 volt transformer like his with it, a 7.5:1 reduction, a 2 volt change at the output translates into a 15 volt change on the Variac, which is larger and easier to control.]

Figure 15 shows the unit in use, checking the B+ winding of a small high-voltage power transformer. With 12V applied to the transformer's primary, the secondary's voltage is 15.33V. With line voltage on the primary, the secondary will produce about 153V, but no high voltage is present in the test arrangement.

Variations of this simple design are possible, of course. Just about any low-voltage transformer can be used. If you don't mind a few more test leads on the bench, you can eliminate the voltmeter and monitor voltage with a multimeter. Alternatively, you could add an ammeter. The enclosure could be commercial or recycled.

I was motivated to build this gadget when its elegant analog voltmeter turned up in my junk box, but it's turned out to be tremendously useful and convenient. Not a month goes by that it's not on the bench and plugged in. You may find one handy, too.

[*WA8MCQ comments*—Although commonly used as a generic term for a variable AC autotransformer, the name Variac is actually a registered trademark. It was held from 1934 to 2002 by General Radio, and in 2004 another company applied for and obtained the name, for the same type of device.]

—DE KCØZNG

More on the BNC Straightening Tool

I ran some info in the October 2001 issue on a tool I made. Sometimes a BNC connector might be somewhat smashed in as shown in Figure 16 and you would prefer to repair if possible rather than replace it.

I made a simple tool, shown in Figures 17 and 18 (top of next page), which could be used to gently work it back into shape. Although the results would not necessarily be perfect, it would still allow the connector to be used. I later loaned it to WJ2V to repair one of his connectors and I used it again myself in 2011. It's one of those tools that you don't need very often (3 uses in 10 years) but are glad to have it when you do need it.

From the 2001 article—

"Figure 17 shows the tool, and figure 18 gives some details. The overall dimensions are somewhat arbitrary. The working end must be able to mate fully with the BNC, and I carefully turned it down on the lathe so it is slightly smaller than the inner diameter of a typical connector.

"The center hole must give clearance for the center insulation inside the BNC, so as to not damage it. (Be sure to make it a little larger to allow extra clearance when it goes in at an angle.) The length and angle of the taper were also somewhat arbitrary, but worked out well. The narrowest part of the taper must fit inside the smashed-in connector.

"The outer diameter of the working section is approximately 0.323" and it tapers down, over a length of roughly 0.100", to about 0.286" at the end. The hole is 0.226" diameter. There was no high power engineering involved; I pretty much winged it, just making something that would work and do what I wanted. Those are the numbers that it ended up with.

"To use the tool, I inserted it as far as it would go into the BNC, which wasn't much since it was partially smashed shut, and then started pushing and moving it around to slowly and gently massage the

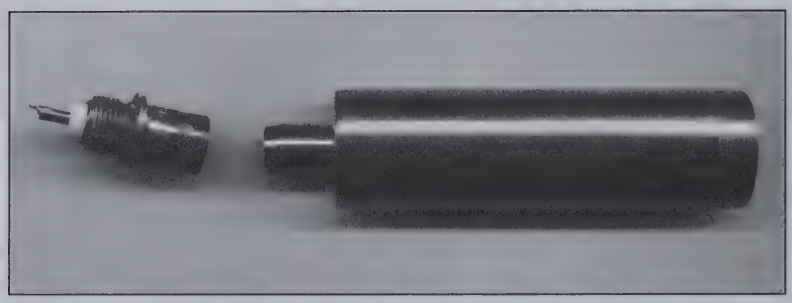


Figure 17—BNC restoration tool.

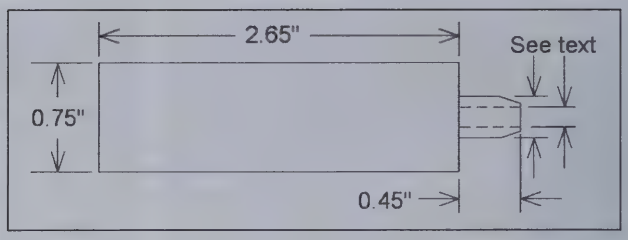


Figure 18—Dimensions of the tool, measured after it was made. Overall length and diameter were somewhat arbitrary, based on material available.

shell back to the original shape as much as possible. There is always the possibility that the shell will crack or break, rendering the connector useless, and taking it slow and easy will help reduce the chances of that happening."

Late last year someone announced on the TestEquipTrader group on yahoo.com that, at request of a local calibration lab, he made a few BNC connector tools. His photo showed a design similar to mine, although his had a flat spot milled on one side of the working end. He said it is pushed in by hand or with a small mallet and then turned a half turn to allow the flat spot to do the work. The body was hexagonal to allow a wrench to be used.

Another person said that he used a socket from a socket wrench set; find the one that would fit into the damaged BNC connector, force it in with a mallet and move it around. He would then use the next larger size that would fit and repeat until the connector was restored.

I test-fitted various sockets at work and hanging on the rack in the tool department at Lowe's (home improvement store) but only one would mate easily with an undamaged BNC connector. Remember, the opening must fit over the center insulator of the BNC without damaging it and the outer diameter must fit into the shell. You could use a smaller diameter socket that would go partially into the damaged shell, work it around a bit to enlarge it, then go to a larger size and repeat, but the center hole of the smaller ones will not fit over the center insulator. Be careful not to drive them in so far that the smaller socket opening damages it.

Finally, a post from Ignacio Cembreros, EB4APL—

"I use for this purpose a hole puncher that has changeable tips; one of them has exactly the same diameter as the BNC connector. These puncher tips are mainly cylindrical except some 5 millimeters at the cutting end which is conical, of course. Even if the connector is badly crushed you can begin with a smaller tip, doing a joy-

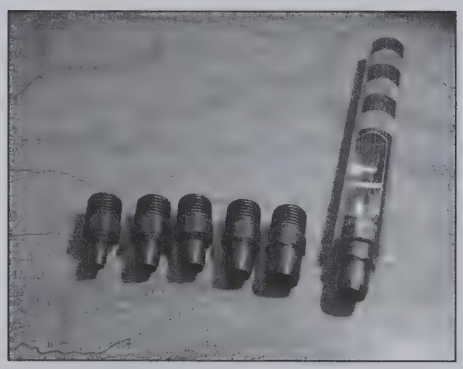


Figure 19—My hollow punch set, which has cylindrical bits. One just fits inside the BNC connectors.

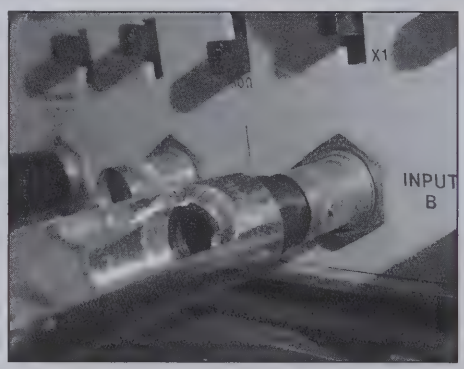


Figure 20—The punch inserted in a good, undamaged BNC; exact fitting.

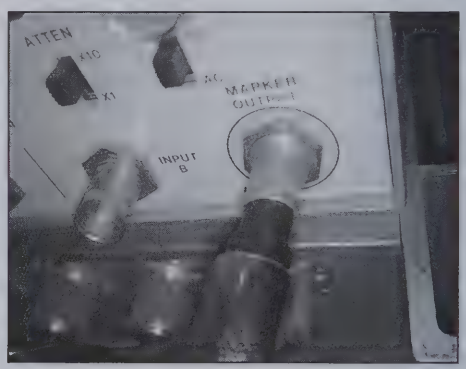


Figure 21—Inserting the punch in a damaged connector. A few taps with a hammer and the connector is fixed.

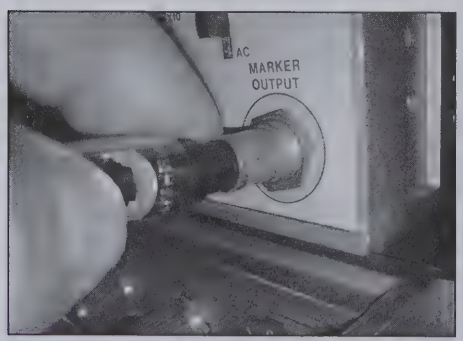


Figure 22—If the crush is severe you may need a smaller punch for starting.

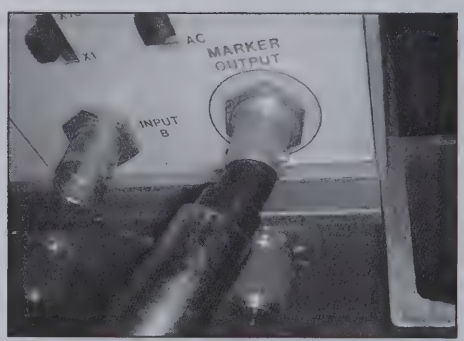


Figure 23—Some "joystick" motion may be necessary.

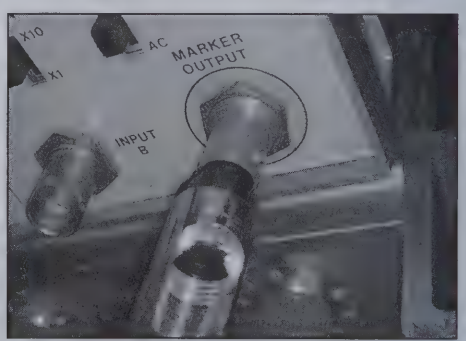


Figure 24—With a few pushes and taps the punch penetrates to the end.

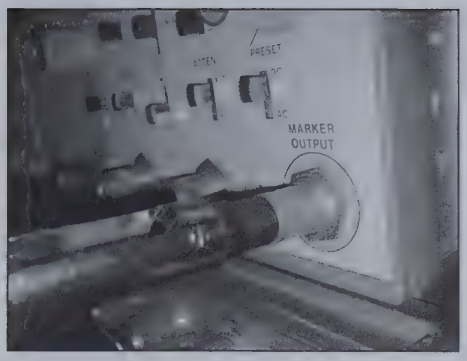


Figure 25—The final touch. A light tap with an oversize punch restores the input chamfer. Done!.

stick motion and finish it with the right one, tapping it with a mallet. The results are fantastic."

He posted a link to some pictures of it in action, shown in Figures 19 through 25 (along with his captions). I asked him where he bought the punch, and he replied—

I bought this tool in an open air market; it was among cheap Chinese tools such as vises and hammers, and I think it is intended for things like leather and rubber. The only identification is the word SEHER and a logo, and Googling on the internet I found a company in India that makes dies. That was probably the origin but it can also be a fake. It is quite long, about 4" from tip to end.

—73 de Ignacio EB4APL

One final note—a word used in a lot of the online posts was "mallet." Myself, I don't think I'd ever want to hammer a tool like this into a BNC connector. I would much prefer to gently massage things by hand, taking it slow and easy, to minimize the possibility of additional damage. That especially applies if part of the BNC shell is slightly ripped or torn; it could split open quite a bit more. Ignacio mentioned "joystick motion," which is exactly what I use.

—DE WA8MCQ

Soldering Alligator Jumper Leads

This is a subject that I've mentioned at least 4 times over the years, sometimes directly and sometimes mentioned in passing in another item (1991, 2002, 2003, and 2007). Someone brought it up recently on the 4SQRP online discussion list, so it's not a bad idea to mention it again for benefit of the newer folks. The bottom line—never trust any alligator jumpers you buy. Before using them, pull back the plastic boot and see if the wire is soldered to the clip. If not, do it now, or sooner or later you'll pay the price when it becomes intermittent.

Depending on when and where you buy them, the wires may be soldered or they may just be crimped in place. (The last set I bought from Radio Shack, years ago, was soldered.) Crimped clips are less expensive to manufacture, but also less reliable in the long run. I buy a new set of jumper leads every several years, as they get lost one by one, and I automatically open them all up and solder as needed.

Figure 26 shows an unmodified clip, and Figure 27 shows one that I soldered.

In most cases, crimped connections are considered to be reliable and robust, but that presumes good, solid, metal to metal contact, something you may not see with jumper leads. On this unmodified clip, the insulation is stripped off the end of the wire and the strands are bent back along the insulation. Both the insulation and wires are crimped together against the clip.

Although this is no doubt quicker and less expensive to manufacture, the wire is held in contact with the body of the clip by the soft plastic, which is not the way to achieve a long lasting, reliable electrical connection. Over time, this compression connection can degrade. Flowing a bit of solder onto the wire and clip will improve the reliability.

My soldered clip in Figure 27 may not look pretty but the connection will last. I don't worry about dressing and trimming the wire to make things look nice, since it will be covered by the plastic boot after soldering. I just hit it with the tip of a soldering iron and feed in some solder until it flows well. Yes, part of the joint will be contaminated with a bit of molten plastic insulation and look terrible, but the joint is still a good one. (It's probably not a bad idea to crimp the tabs again with a pair of pliers, since the plastic has flowed a bit, to insure that there's some strain relief on the soldered joint.)

Until recently, my last purchase of leads was 4 or 5 years ago, at Radio Shack. I was pleasantly surprised to find that all of them were already soldered, as shown in Figure 28. However, to be safe, I resoldered all of them anyhow so I could be sure of the quality of the solder joint. Just because solder is visible doesn't mean that it is well wetted to the clip. As a former US president said, "trust but verify." (Long time readers may recognize all of these photos, which have appeared before.)

Everybody who responded to this on the 4SQRP list said they solder theirs. Here are some of the comments—

From Jim, WØEB—

Yup, I always do that, but there's one other consideration. By soldering, you actually weaken the wire, so it's best to solder it ahead of the little loop that it passes through and make sure there's bare, stranded wire behind that point. Also, after soldering, if the crimp ears haven't been folded over the insulation, do that as well but not so hard as to cut through it. That acts as a "strain relief" and will make them

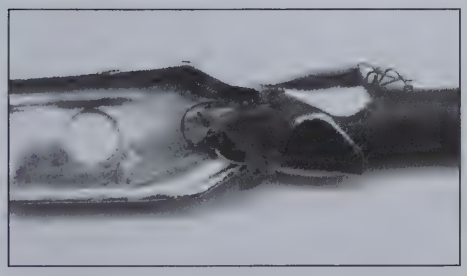


Figure 26—An alligator clip jumper lead with a crimped connection. Long term reliability is doubtful since insulation is included in the crimp.

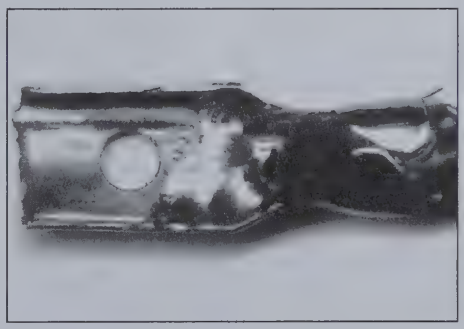


Figure 27—Soldering the wire to the clip greatly increases reliability.

Figure 28—An alligator clip jumper lead from Radio Shack, several years ago. The wire is soldered but I later added more solder to be safe.

last even longer. I've noticed in the ones I've bought lately that they usually don't crimp the ears and that definitely needs to be done to prevent the clips pulling off the "wahr"!

From Wayne, KCØPMH—

The way I "strain relief" my patch leads is before I crimp/solder I slide an inch or so of heat shrink sleaving on and then when the joint is made slide it back over and shrink it down. Heat shrink "guns" are about $10 at Harbor Freight and are good enough for occasional use.

From Dale, WC7S—

Step back in time with me to the first set of clip leads I found under the Christmas tree. "WOW" I thought, what a time saver; great invention and a whole set of them; and I hit the workbench. The first few times I used them, they were fine. Shortly after that, however, I found out that sometimes one only seemed to work when it wanted to, completely frustrating and totally extending the time of repair. So, lesson learned; now, brand new or newly found, they all get recrimped and soldered. And many of them, now found in certain stores, get the wire replaced BEFORE it fails with even more frustration exhibited.

—DE WC7S

I asked Dale about his replacing the wire and he replied with this—

Many times I replace the wire in the clip leads that I buy because the wire is too light or nor rated to carry the current that will be applied. So rather than replacing it after it has been used as a too-small fuse, I'll just replace it first. However, I also use the current carrying rating to protect a circuit with the "fusible link" of the wire. Leads at the dollar stores are always suspect, but I always check the length and quality of the wire and the quality of the clip before buying. It doesn't fare well for the circuit on the bench to have the clip come apart, dropping a piece of the clip one way and the "hot" lead another way. If the wire and the clips are poor, chances are, I will find them somewhere else.

Final WA8MCQ comments: I just went to Radio Shack to pick up my latest replacement set of leads and they still look pretty much like Figure 28, with the wire soldered and the tabs crimped over the insulation for strain relief. I'll examine them under magnification to be sure the solder is well wetted and reheat as needed, but in general they look like they should be trustworthy as they are.

I looked around the workshop a bit and came up with some other old clips of various vintages. Some, with "KOREA" stamped in the metal, had real, actual crimp connections with a complete metal to metal connection around the wire. I had flowed some solder onto the crimp just to be safe, although it was probably unnecessary and would have most likely lasted forever as it was. At the end, the metal was also crimped onto the insulated wire to provide strain relief. (That was another actual crimp, done by machine, not just ears folded over onto the wire.)

—DE WA8MCQ

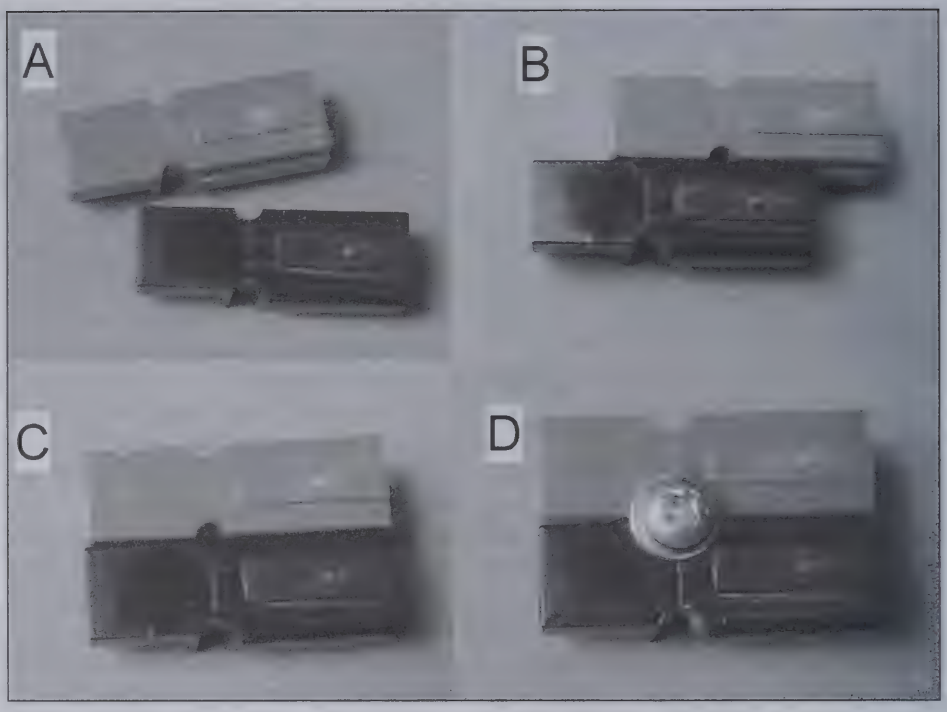


Figure 29—Anderson Power Pole connectors slide together (A, B, C) and putting a pin or screw in the hole (D) keeps them from sliding apart.

Reinforcing Anderson Power Pole Connectors

From Charles Moizeau, W2SH—

When assembled, Anderson connectors are frequently connected and disconnected, their hoods tend to slip out of alignment with each other. Commercially available are steel pins, called "roll bars," that fit through the small hole formed by the paired hoods. Hams have substituted short pieces of 14-gauge wire, or just epoxied the hoods together. Here's a more elegant solution I've developed and it only takes a couple of minutes to accomplish.

Accurately pair up the connectors with the surface showing their two slightly raised bosses facing upward (the surface with two small indentations will face downward). Secure the accurately paired connector in a vise with padded jaws.

Place a drop of liquid dishpan detergent on the small hole. Run a 4-40 thread tap all the way through the hole and clean it out with a damp pipe cleaner. Insert a 5/16" long, 4-40 pan-head or round-head screw into the threaded hole and tighten, but not excessively.

WA8MCQ comments—Although I've heard of them for years, I've never seen them in the flesh. Charles sent me a set to

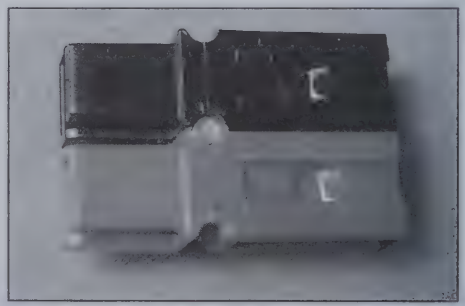


Figure 30—The other side of the connector. Choose a screw length that does not extend out of the hole.

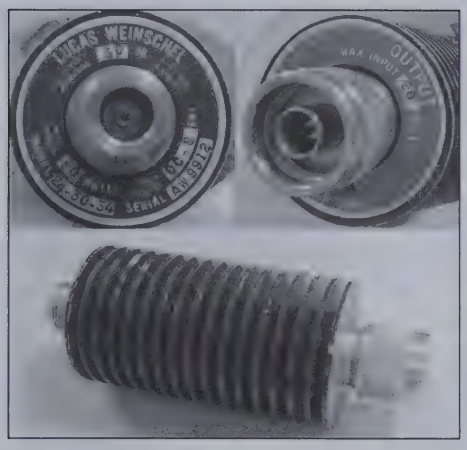


Figure 31—Some attenuators have a lower power limit on one end, such as this Weinschel model. Not obvious in the photos, the lower powered end has a red label.

play with as well as the finished product. Figure 29 shows the basics; the plastic shells are designed to be joined to each other and slide together (A, B). The indentations on the sides form a hole in the middle when mated up (C), but there is nothing to keep them from sliding apart later. Putting something into the hole takes care of that (D), preventing movement. Figure 30 shows the underside.

(A lock washer may or may not be needed. The samples he sent me use the type of screw that comes with a captive lock washer.)

—DE W2SH

Asymmetrical Power Attenuators

A while back someone on the HP/Agilent equipment forum on yahoo.com said that the connectors on a high power JFW attenuator he had were not marked and asked if it mattered which end is used as an input. He said that he had seen power attenuators marked with input and output and assumed that it does matter.

IK1ODO replied that some power attenuators are symmetrical with respect to power ratings and some are not. He said that those that are not symmetrical (such as some models from Bird, Narda and Weinschel) have input and output clearly marked. He also indicated that the power that can be applied to the end marked as output is usually a fraction of the total power rating.

He provided a link to the unit in the online JFW catalog and said that this

Figure 32—A 30 dB power attenuator with the same 100 watt rating on both ends.

model is symmetrical since it is not specified otherwise. (The owner later called the manufacturer, who confirmed that it is symmetrical.)

It's normally safe to presume that an attenuator can be used with either terminal as the input unless marked otherwise. However, there are some that are asymmetrical (or unidirectional, as JFW and Weinschel call them). It costs a certain amount to make an attenuator which can handle, say, 100 watts input at either end. But not every application really needs an attenuator that can take full power in both directions. If power will only be applied in one direction, one end can be designed for less power and the cost will be less. (The Weinschel web site also notes that it allows for smaller overall package sizes.)

Figure 31 is an example of a "one way" attenuator. This 30 dB Weinschel model is rated at 50 watts on the nominal input side and 20 watts on the output. Both ends are clearly marked with the power rating, and on the 20 watt end the label is red instead of black to make it harder to overlook. Power may be applied to either end as long as the user observes the limits.

One unidirectional attenuator series listed on the JFW web site has an input power of 500 watts, with a reverse power rating of 125 watts. Another has input power of 1000 watts and a reverse rating of 125 watts. Although no photos are shown, I would expect that the lower power ends are well marked.

I happen to have the same model that the person was asking about, shown in Figure 32. Made by JFW, this one is rated at 100 watts (on both ends) with an attenuation of 30 dB. (It was picked up on eBay for about $30 a few years ago. Ones that were listed since were not so low.) It makes a good tap for monitoring a 100 watt transceiver on a spectrum analyzer. Additional attenuation will usually be required to protect the analyzer, but can be done with low power attenuators. It can also do double duty as a dummy load.

—DE WA8MCQ

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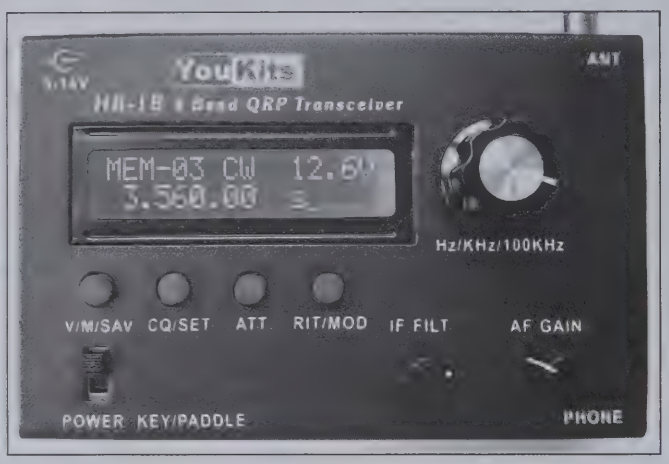
Review: The YouKits HB-1B Four-Band QRP Transceiver

T.J. "Skip" Arey—N2EI tjarey@gmail.com

Few, if any companies, have been as dedicated and supportive of the QRP community as TEN-TEC. I would venture to say that, over the years, a great many QRP enthusiasts have benefitted from the incredible design work of TEN-TEC President Jack Burchfield K4JU and his team. Those of us with more than a little grey in our beards can remember beginning our QRP experiments with the TX-1 transmitter module or one of the Power Mite series of transceivers. Sturdy and dependable, my TEN-TEC Argonaut II is still my "go to" rig for QRP SSB contesting. So when TEN-TEC entered into a relationship with the Chinese manufacturer BD4RG, I was initially skeptical.



My fears were allayed when the TEN-TEC R4020 and R4030 Two Band transceivers proved to be excellent choices for hams who like QRP and who also like to radio out of the shack and into the wilds. Chuck Skolaut KØBOG's review of the R4020 in the February 2011 issue of *QST* proved that this corporate partnership was going to be very positive for the QRP community at large.

TEN-TEC has announced that they will be the exclusive U.S. distributors for the new YouKits HB-1B Four Band QRP Transceiver (Part #R4040 $299.00).

Let's get the meat and potatoes technical facts out of the way so we can move on to how much fun this radio is on the air. The HB-1B is a 80/40/30/20 Meter Band CW QRP Transceiver that can also continuously tune from 3.2 to 16 MHz in receive mode. In spite of full four band coverage, the HB-1B is physically smaller and lighter than its R40XX stable mates. It has the same sturdy metal case structure as its sister rigs, but its overall size is only 5.2" x 3.35" x 1.4" and it shaves almost 3 ounces off its weight at 13.4 ounces. This may not seem to be a great deal to most folks, but have a talk with any backpacker or long distance bicycle tourer to learn its significance.

Designed as a "go anywhere" radio, the HB-1B can utilize any external 9 through 14 VDC power source. And, the HB-1B continuously displays the available battery voltage. Very useful in field operations. Importantly, if using external power, the unit has a polarity protection circuit built in. We all make mistakes! At 12 VDC, its output is rated between three and four Watts. 13.8 VDC yields between five and six watts. Generous by QRP standards.

The unit I received for review included the optional 12 VDC 2.2 Ah Lithium battery pack and charger (Part # R9411 $29.00). The HB-1B's current drain at 12 VDC is about 60 ma on receive and 800 ma on transmit. Using the internal battery pack, this is more than enough juice for a fun weekend of woodland ragchewing in between other outdoor activities. The HB-1B also ships with a three cell battery holder to make use of your own Lithium Cells (Note: Traditional Alkaline Cells are not appropriate for the HB-1B). There is a modification required if you plan to use this battery holder and it can be found at www.youkits.com .

The HB-1B has a variable, 4 crystal IF bandwidth filter, adjustable from 400 Hz through 3 kHz. While the filter is intended to be wide enough to allow monitoring of upper and lower sideband voice phone signals, I found the widest setting sufficient to resolve many shortwave broadcast signals as well. I found this IF control to be reminiscent of the variable IF bandwidth control on my old Argonaut II. The continuous flexibility this feature provides puts this portable rig far ahead of many competitors in my opinion.

The internal keying circuit automatically recognizes if you have connected paddles, a straight key or no key, giving an audible signal through the headphones to indicate this state. Keyer circuit speed is adjustable between about 5 and 35 WPM. The unit's side tone is set at a pleasant pitch of 700 Hz.

Audio output is about a tenth of a watt. More than enough to make your ears ring with any recommended 8 - 32 ohm impedance stereo headset.

The HB-1B is simple to use right out of the box. Just four buttons, three dials and a power switch. Operation is so simple that the manual is a scant four pages long. It took less than one afternoon of casual operating to become completely comfortable with this transceiver's controls and capabilities.

Frequency adjustment can be done in 10 Hz, 100 Hz or 1 kHz steps. The radio can store up to 30 frequency locations in memory, This is accomplished by manipulation of the V/M/SAV button and the main tuning control.

The ATT button activates the receiver attenuation circuit to help with strong signal overload.

The RIT/Mod button actives the receiver incremental tuning and allows for switching between CW and upper and lower sidebands.

The bar graph provides frequency, power and control information. As a power indicator, it is calibrated so every three bars on the display indicates 1 watt of output.

A feature unique to this unit and its sister rigs is the Automatic CQ function. This allows you to enter your call sign to generate a standard 1x3 CQ call. This points to the one change I would request in the design. The call sequence ends by sending "PSE K". While there is nothing technically wrong with this, (it certainly is polite) I can't recall ever hearing it on the air. [*More common in the past, but still occasionally heard —Ed.*] I would suggest that the memory be reprogrammed to send "/QRP K" or just "K".

You enter your callsign into memory and adjust the keyer sending speed by

manipulating the CQ/SET button.

The remaining two dials adjust the IF Filter bandwidth and the AF gain. Self explanatory in either case.

Once I installed the battery pack and brought it up to full strength with the supplied charger, I went out to standard QRP calling frequencies and reports all indicated excellent tone and no drift. With so many modern transceivers having dozens of controls and a manual so full of information that it weighs more then the radio, the simplicity of getting on the air with the HB-1B brought a great deal of fun and excitement back into my regular QRP activities. The digital frequency display, built in keyer and variable bandwidth filter puts this radio a cut or two above many simple home brew rigs.

But this diminutive rig needed to be taken outdoors for a real trial. TEN-TEC was thoughtful enough to include an "over the shoulder" carry-all that they will be marketing to hams who enjoy taking their radio play out into the field. (Part # R9920 $39.00) I loaded the HB-1B, a couple of dipoles, Vibroplex Code Warrior paddles, a sandwich and a water bottle into this durable bag and hopped on my mountain bike for a trip out into the new Jersey Pine Barrens. There is nothing quite like getting out away from power line and people noise to really make QRP fun!

The HB-1B does not have an automatic antenna tuning circuit so it is necessary to use tuned antennas or supply your own tuner. For this test, however, TEN-TEC also supplied me with a YouKits FG-01 Antenna Analyzer. (Part # R9410 $249.00) I will write more about this unit separately but suffice it to say, the graphic display allowed me to quickly tweak my dipoles to a center frequency on or near the QRP calling frequencies. It also gave me a graphic display of the SWR curve so I knew how far I could wiggle around on the band before adjusting the antenna further.

In addition to selling the HB-1B as a stand alone device, TEN-TEC is considering making a "grab and go" package consisting of the transceiver, antenna and paddles along with the shoulder bag previously mentioned.

For those with an experimental attitude, I couldn't help but notice that there is a small but adequate empty space within the rig's case to allow for personal modifications and improvements.

At $299, the HB-1B is going to be a strong player in the QRP market. The YouKits HB-1B is being distributed exclusively in the United States by TEN-TEC, Inc., 1185 Dolly Parton Parkway, Sevierville, TN 37862, (800) 833-7373, www.tentec.com

●●

162 Countries on a 10-Foot Whip

Paul Signorelly—WØRW w0rw@msn.com

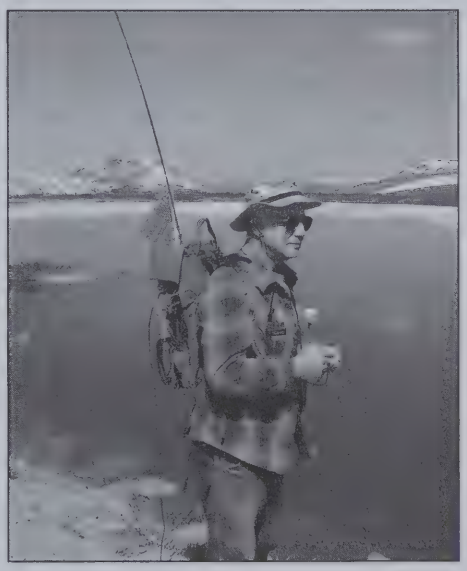
I finished my WAS/pm (pedestrian mobile) in 2004, and reviewing my Pedestrian Mobile log I noticed that I had already worked over 50 countries. So I decided to work a few more, how hard could this be?

These contacts were made using my PRC319 military backpack radio (50W) using a 10 foot whip that is attached to the backpack. The radio is powered by LiON Cells and weighs 23 pounds. Actually, I had worked Costa Rica, Latvia, Estonia, Canada, Virgin Islands on 20M. Then, I got Belize on 40M with my Elecraft KX1 (3W) using the same whip and a 30 foot drag wire walking out on the street at night.

The photo is of me operating CW at Independence Pass, Colorado, elevation 12,000 feet.

The DX contests can help when you are just starting your DXCC/pm, but I have found that frequently when the propagation is good enough for the DX to hear you the pile up is too big to break.

The spring of 2005 had some good 15-meter openings that helped a lot. My whip antenna is more efficient on 15 meters since it is close to a quarter wave long. 15



meters skip is also more unique, allowing European signals to skip over the East coast and to drop right into Colorado (sometimes). I can move my drag wire (counterpoise) around to peak stations up and have a little less loss.

Fall of 2011 has seen 10 meters open up and I have been able to add a few more countries to my list using an 8-foot whip.

Working the last few countries was like looking for love. It is like a butterfly. If you chase it, it will elude you. But when you sit and rest, it will come and land gently on your shoulder.

The ARRL does not issue a special WAS or DXCC certificate for Pedestrian Mobile operation. However, you can get a unique Pedestrian Mobile certificate for WAS/pm or DXCC/pm from The Great OutDoors Radio Club. Just go to the GORC web site at: http://www.wa3wsj.org/GORC1.html

For more information about Pedestrian Mobile operation see WA3WSJ's new *Amateur Radio Pedestrian Mobile Radio Handbook* that is now available at Lulu Press; http://www.lulu.com/product/paperback/amateur-radio-pedestrian-mobile-handbook/16364181. You can preview the first 12 pages online.

There is also a pdf version available at http://www.lulu. com/product/file-download/amateur-radio-pedestrian-mobile-handbook/16364182. You can get the *Pedestrian Mobile Handbook* or the WØRW/pm Article Collection on a CD at http://wa3wsj.homestead.com/WA3WSJ-Wutz-Publishing.html

—Paul, WØRW/pm

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Return of the Dual Gate MOSFET! Part 1

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Some would question "What do you mean return? Does this take on Biblical proportions like the return of the Prodigal Son?" Read on and you'll find out.

The real question is what is so special about the Dual Gate MOSFET (DGM) and why does its supposed return have any meaning in 2011? Well, the answer really lies in the past. For many "old time" home brewers, the venerable RCA 40673 DGM was the basic staple of many radio projects in the 1970s and 1980s. There were designs that included use as RF amplifiers, converters, mixers, IF amplifiers, product detectors, variable frequency oscillators, buffer amplifiers, transmit amplifiers, etc. That very same 40673 and its many cousins have even appeared in many well-known commercial pieces of ham equipment. But then the next new wave of technology hit and suddenly the Dual Gate MOSFET was phased out of designs and out of production. DGMs became scarce and if you can find them now, the prices are in the $5 to $10 range for a single unit.

Fortunately, a new crop of DGMs has appeared, this time as surface mount components. I first learned of these DGM's from a comment on Wes Hayward, W7ZOI's website. He mentioned the BF998 from NXP (formerly Philips). This led me to an investigation which unearthed a whole range of DGM's from NXP and the prices are unbelievable. Imagine the latest state of the art DGM with a price as low as $0.17 for a reverse model. For the standard model the cost is $0.40 in single lots. So OK, what is this reverse and standard model? Typically the standard pin-out when viewed from the top has a "fat" or thick pin out at 4 o'clock. This is the Source pin. Next it is Gate 1 at the 8 o'clock position and Gate 2 which is at the 11 o'clock position. Finally, the Drain appears at 1 o'clock. For the reverse model, Gate 1 is at 1 o'clock, Gate 2 is at 4 o'clock, Source (fat pin) is at 8 o'clock and Drain at 11 o'clock. Aside from turning this around in your head—interfacing does present some challenges as the standard model facilitates the flow of input and output circuitry. At least for me it is easier to understand.

What's so good about DGM's? The short answer is versatility and typically a lowered part count in many circuits. The dual gates are responsible for the lowered parts count. Each gate can independently control current in the DGM. This means one gate can be used to amplify a signal and the second gate can be used to control the gain of a low level amplification stage. A normal JFET such as the MPF102 would typically require a second active device to control gain. Alternatively, one gate in a DGM can be used to form an oscillator and an external signal of a different frequency can be input via the second gate. This causes the DGM to operate as a mixer for frequency conversion. Again, a normal JFET would typically require a second device for the oscillator.

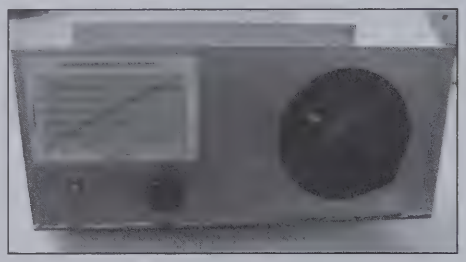

Figure 1—The completed direct conversion receiver.

Now the purists may plunge in and tell you about all of the short comings of the Dual Gate MOSFET such as overloading and signal isolation. That can be true in some instances, but the new generation of DGM's are much improved in their performance. I have recently built circuits using the 40673, as I purchased a stock before they became "unobtanium". Replacing that device with a BF991 (a new offering) gave greatly improved performance in the same circuit. I would have to agree that the DGM is NOT a "one size fits all" device, especially if one is building a laboratory grade instrument. But, they are often quite useful in building amateur equipment and can often give perfectly satisfactory performance at low cost.

Does this suggest that a single device could be applied in many stages of a ham receiver or transceiver? The answer is YES and future parts of this article series will explore this idea. However, it is useful to start with a much smaller project and explore what DGM's can do for you. Our strategy is to use new components in old designs that are known quantities, as these circuits have a known baseline. As a

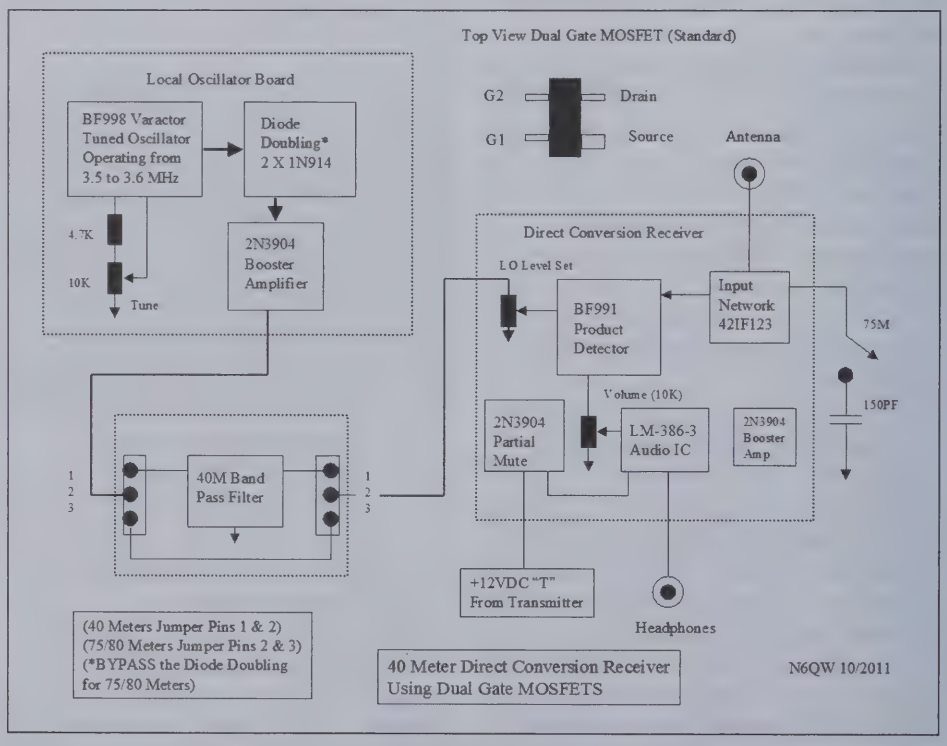

Figure 2—Block diagram of the dual gate MOSFET direct conversion receiver.

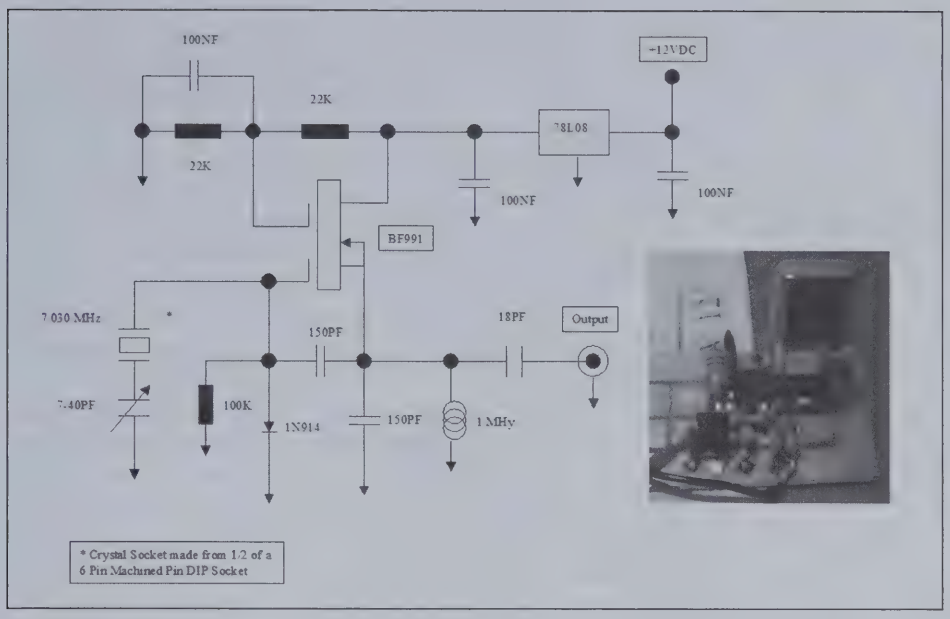

Figure 3—Test oscillator.

Figure 4—Completed DC receiver board.

bonus, those of you who are newcomers to home brewing or who may not have built something in a very long time can ease into home brewing without too much angst. The objective is to have you say "I built that, it is usable and I know how it works!"

It's only fair to warn you that all of the current DGM devices are surface mount components. However, I will show you three techniques to successfully mount these DGM's without damaging the device or inadvertently soldering your fingers to the board. One involves the use of an Xacto-type knife and a steel square with single sided copper vector board or PC Board material and another a 4-pin socket available from Mouser. The detail of the three methods is found on my website at http://www.jessystems.com/DGM.html. You will also find there material concerning a test oscillator, RF probe, some tips for checking each stage after construction, breadboarding for final integration and soldering surface mount components. Look for "N6QW's Konstruction Korner." All of the new DGM's are surface mount. The major point is that you will need a temperature controlled soldering station. Your old 80 watt Radio Shack soldering iron won't be suitable. And you will need a magnifier of some kind to examine your solder joints.

Building a 40M Direct Conversion Receiver

We will start off with a simple, low part count, Direct Conversion (DC) receiver using two DGM's. DC receivers operate by converting RF signals directly down to audio frequencies and then providing all of the gain needed to make them audible via audio amplification. Typically, such a receiver has a band pass filter at the front end leading to a product detector (mixer) where the signal is mixed with a variable frequency local oscillator (LO). The LO operates at a frequency separated from the RF signal by a convenient audio range frequency, say 1500 Hz. The audio-range output is then amplified as needed for audibility. For CW, you will also copy the signal either side of "Zero Beat" but that is not a problem as the ear does a wonderful job of sorting this out. Figure 1 shows our finished product. The case, made out of blank PC board, is 7" x 5" x 3" which is a standard commercial size. A commercial case could be used to house the radio and it would give it a more professional look. But "rolling your own" is far less expensive. Don't expect this receiver to have all the features and performance of an Elecraft K3 or Yaesu FT-5000, but you will find it to be usable and work surprisingly well. It's a great beginning project that can be accomplished with simple circuits and very little money. Take the plunge—you can do it!

To keep things simple, the DC receiver will be placed on the 40M band as this band almost always has activity. Moreover, high power AM foreign broadcasters are leaving the band, thus reducing interference. The DC receiver can also be easily converted to 75/80M since our LO signal will originate on 75/80M and is then doubled to reach 40M. Of course, the input tuning network will require a minor change (one capacitor) to reach the lower band.

A block diagram for our version of the DC receiver is shown in Figure 2. It features two different DGM's. A BF998 is used as a Varactor tuned Local Oscillator (LO) and a BF991 is used as the main "detector element" of the direct conversion receiver. Either DGM will work in either part of the circuit, but I wanted to experiment with different DGM's.

The DC receiver is shown built on three PC boards. The receiver (detector) and audio amplifier are on one board, the LO is on a second board and the 40M Band Pass Filter is on the third board. There is no reason why all could not be built on a single board. But, the use of separate boards allows experimenting with various circuits. Board sizes are generous. The size of the DC receiver board is approximately 3" x 2", the LO is 3" x 3" and the Band Pass Filter 2" x 1". While it would be so cool to build the whole radio inside of a matchbox or "fat" old style fountain pen, that is best left to others. If you stick with these sizes you will have plenty of room and will not risk damaging components while trying to solder in tight corners. I strongly suggest drilling the corner mounting holes in each board before adding any components. You do not need a wandering drill bit to accidentally skewer a Dual Gate MOSFET. In the case of the LO, I added a few more mounting holes near where the toroid is mounted on the base plate so this board is solid and not prone to any movement. Follow my general layout as can be seen in the various figures and you will be in good shape.

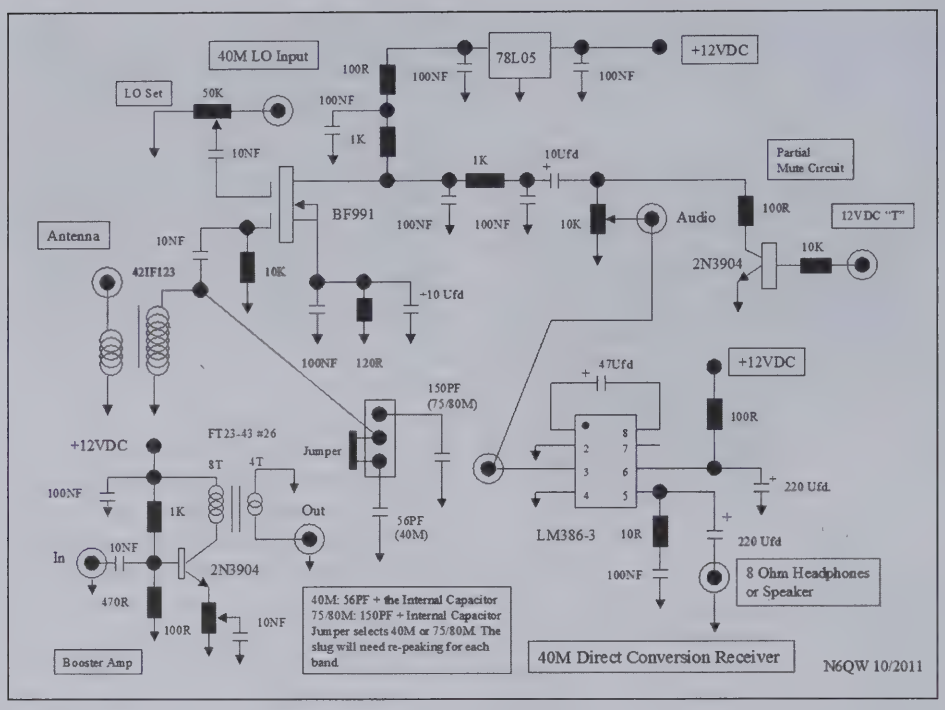

Figure 5—DC receiver board schematic.

The How-to-Build-It Part

As usual with my projects, we will follow a plan that allows what is already built to become a part of the testing scheme for stages to follow. We will also start with easier circuits first as that will enable to new builder to develop skills needed for the more complex circuitry.

Starting at step "0", it is important to build the crystal test oscillator shown in Figure 3. This is slightly different from the test oscillator on my website in that it uses a DGM as the active component. This oscillator, as one Marine Drill instructor once told me about my M-14 rifle, is your best friend. It will:

- Give you practice in working with a surface mount DGM, creating mounting pads and laying out a circuit.
- Serve as a signal source to test and see if the receiver is working.
- Be used to align and center the 40M Band Pass Filter so that the filter is centered on the active part of the CW band.
- Be used to test drift in the LO.
- And, it will be a low-level stage of a companion transmitter presented later.

The special 7.030 MHz crystal can be purchased through Kanga US, http://www.kangaus.com/misc__parts.htm. They have plenty available. I also recommend using a crystal socket made from half of a 6 pin machined pin dip socket.

Once built, there are several ways to test to see if the test oscillator is working. After building the circuit, as is my usual process, check for wiring errors (yes, I made one) and look for any shorts or solder bridges. Insure that the power leads are connected properly and that the voltage regulator is installed correctly. Then take a coffee break before applying power. One more check and then you can provide power. One way to test the circuit for operation is to use a home built RF probe connected to a Digital Voltmeter (DVM). I have covered the construction of such a probe in several previous articles and it has but three parts, a 1N34 diode, a resistor and a capacitor. See my website for the schematic. The probe will show you that there is RF coming out of the circuit. You can also use an Oscilloscope connected to the output. I saw about 1 volt peak-to-peak (~ +4 dBm). The other method is to listen for the signal on an external receiver tuned to 40M. The trimmer capacitor enables setting the frequency to 7.030 MHz. I used all three methods.

The next build is the Direct Conversion receiver. Figure 4 is a photo of the completed DC receiver Board and Figure 5 is the schematic. For the new(er) builder, I would suggest using the single sided copper vector board as the method of construction. The simple reason is that if the 4-pin socket method is chosen, then NO board square cutting is required. Even if you choose not to use a socket with the single sided vector board, there are only four squares to cut for the single BF991 DGM. In either approach, virtually all other wiring is done on the insulated side of the copper vector board. As usual, components that are connected to ground are simply soldered to the top of the board. Those that are connected to other circuit elements are passed through the holes. As mentioned in my prior articles, I take a 1/8-inch drill bit that has a 1/8-inch knob installed on the shank end. For components passing through the board a few twists of the drill bit clear the copper around the hole so there is no short to ground. The single sided copper vector board will need some short aluminum type pillars installed to elevate the board so the underside connection does not short out. More experienced builders may decide to use the cheaper alternative of cutting squares for all components on blank PC board, as shown on the pictures in this article. However, this method requires more attention to component placement and that might be a distraction for a new builder.

Start first with the audio amplifier. Use of the vector board would facilitate using an 8 pin socket and I heartily recommend using a machined pin socket. The pins are slightly larger than the vector board holes. Thus, carefully enlarge the holes and clear the copper from around each hole. This will enable a tight fit of the socket and will hold things in place. Finish the wiring, check it and test this part of the circuit by connecting either an 8 ohm speaker or 8 ohm headphones and apply power. Touch pin 3 with a screwdriver and you should hear a distinctive sound that it is working. Not working? Start the troubleshooting process. Solder Bridges, shorts, no voltage on Pin 6, IC in the socket backwards. There are so few components that the fault can be remedied quickly.

The schematic of Figure 5 shows some extra circuitry including a 2N3904 Booster Amp which is not required for operation but if you want to try some other LOs you need to have a minimum of 1 volt p-p (+4 dBm) of LO drive. It is not required

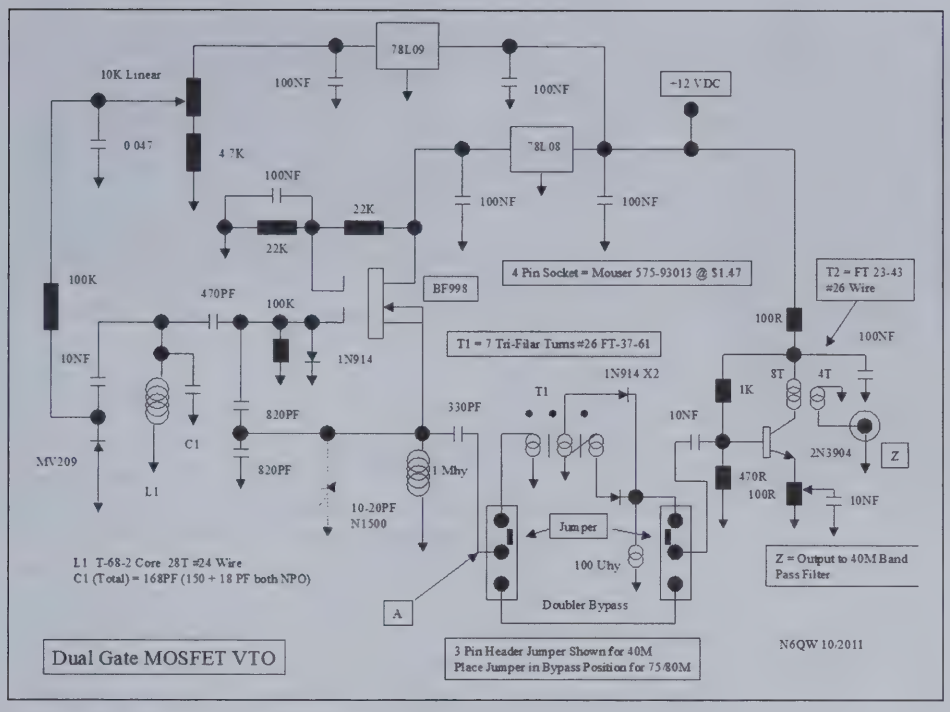

Figure 6—Schematic of the local oscillator.

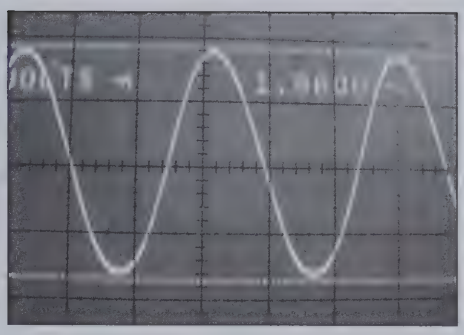

Figure 7—LO output waveform.

for the build but is provided if further experimentation is desired. The second 2N3904 transistor is used as a partial muting circuit. This is included so that, when the receiver is used with its companion transmitter, you can listen to the transmitted signal at a significantly reduced volume. My hearing has already been ruined by too many rock concerts and what little I have left needs to be protected! Notice also that there is a 56 pF padding capacitor added to the 42IF123 transformer. This is in addition to the internal capacitor in the transformer. If you will later be interested in 75/80M operation, you will also want to add a three pin PC board header and removable shorting plug to switch between the 56 pF capacitor and a 150 pF capacitor for the lower band. The tuning slug in the transformer will also require retuning for 75/80M and again when switching back to 40M.

The small pot located in the Gate 2 circuitry as I mentioned previously is to adjust the LO level to the BF99X (BF991, BF998, BF994). If too much drive is applied the DGM will overload and you can hear that in the recovered audio.

With the wiring of the Direct Conversion receiver board completed it is now time to test the radio. First go through the usual steps of checking wiring, look for solder bridges, shorts, wiring errors and parts installed backwards (voltage regulator) etc. Take a coffee break and then begin testing. For this initial test we can operate the DC receiver on a single frequency. This is where the test oscillator that we initially built comes into play. Power up the oscillator first and insure that it is working properly.

After you are absolutely certain there are no wiring errors, etc., plug in the earphones (8 ohm) apply power to the receiver. There is a good reason for repeating the checking of everything and that is replacing a smoked DGM soldered to the board is no simple task! Once it is installed, nothing short of a blowtorch is needed to remove it in one piece. If I suspect I have smoked a part, the simplest method is to take a pair of fine point wire cutters and simply cut it off the board taking care not to destroy the pads you worked so hard to fabricate. Did you remember to hook up the antenna? Yes, you will need an antenna tuned to 40 Meters.

Given that the DC receivers are prone to hearing AM stations, you most likely will pick up a station or two. If you turn the slug on the 42IF123 transformer you will really hear those stations. That is not where you want the slug BUT it will tell you that your DC receiver is working. [For the not so faint of heart touching the top end (ungrounded) of the LO level set pot with a metallic object should produce a "hum". USE an INSULATED screwdriver as you risk blowing the device since the DGM's are static sensitive.] Power down the DC receiver. Now hook up the test oscillator you built and temporarily tack a short lead from the 18 pF coupling capacitor to the top end (ungrounded) of the level pot. Power up both the radio and the oscillator. You should hear some CW stations albeit on a single frequency. Peak the input network to a point that maximizes the signal. That is the place where you want the network tuned. Here on the left coast, the signals on 40M seem to be a maximum in the early evening and so if you ran this test at midday you might not hear too much. So picking the time to run this test is a factor. If the radio at this point did not pass the test then you need to conduct the usual troubleshooting process. Make some voltage measurements such as checking for the regulated 5 volts and the presence of a voltage on the drain of the DGM. This is a little late to ask, but is the DGM installed correctly? Once you have completed all tests and the receiver board is working, put it aside and out of the way.

The simplest LO to build operates at 3.5 MHz using the BF998 and is then doubled to the 7.0 MHz output frequency using diodes. Figure 6 is the schematic. Output is quite clean as shown by Figure 7, which was taken at Point A in Figure 6. The doubling circuit works quite well in reducing the primary input frequency but introduces a 7.5 dB loss. So, I added a small transistor booster amp using a 2N3904 device and for good measure a 40M Band Pass Filter to remove any remaining 3.5 MHz fundamental component. The one issue with this approach is that any drift at 3.5 MHz is magnified x2 at 7.0 MHz. If you are using the vector board approach, I recommend that you add two

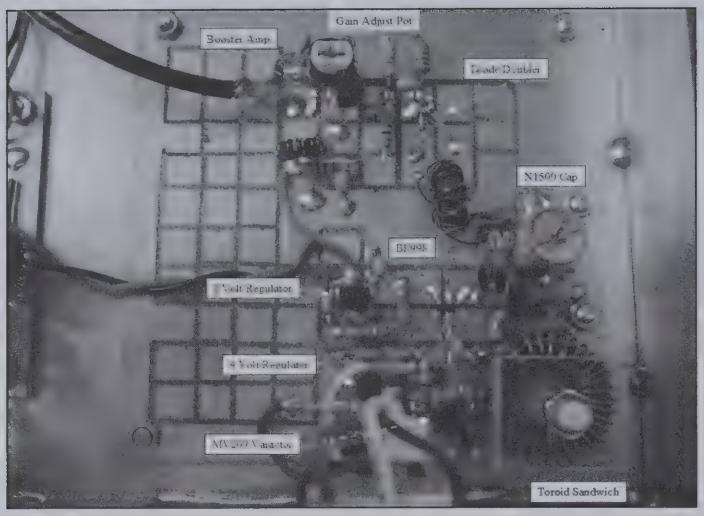

Figure 8—Completed local oscillator board.

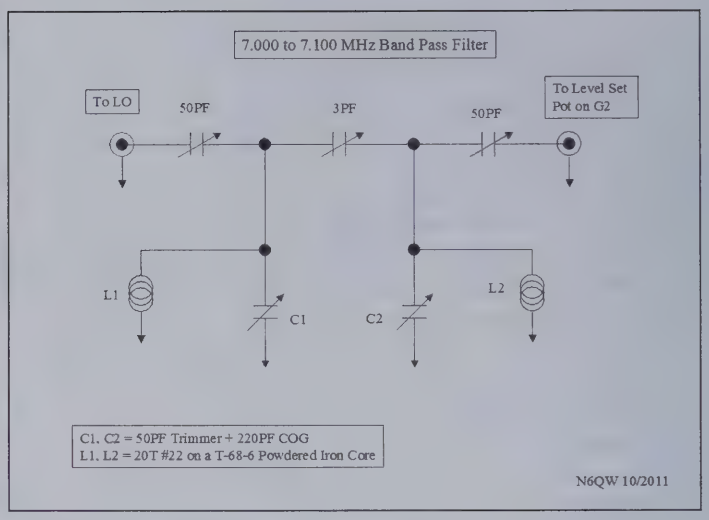

Figure 9—Bandpass filter schematic.

more holes for an additional set of pillars halfway down the long sides of the vector board used for the LO. This will make a total of six pillars to support the LO board and will help prevent a move in frequency if the desk or table holding the receiver is bumped. As always, it's best to make the six holes before beginning construction.

But if built using some good practices, the drift can be minimized. The toroid inductor will be a major source of drift unless it is immobilized as shown in Figure 8. Movement of the toroid or expansion/compression of the turns of wire will increase or decrease the generated frequency. The process requires two postage stamp size pieces of 3/16 inch thick plexiglass with drilled holes in the center of each piece for a 6-32, 1 inch long nylon screw. The bottom piece is counter sunk the hole so that the flat head screw is flush with the bottom of the plexiglass. With the screw in place, take out your handy "super glue" and glue the assembly to the circuit board so that the nylon screw is facing upward. Give that a few minutes to cure and you are in business. The toroid is then slipped over the screw and positioned so it is centered on the screw. The top piece of plexiglass is then placed on the nylon screw forming essentially a toroid sandwich. Tighten the nut, which in this case is a stainless steel 6-32 nut so that there is no movement of the core. The reason for the plexiglass and nylon screw is that any metallic devices tend to affect the inductance of the toroid. stainless steel is non-magnetic and so not so much of a problem.

Capacitors in frequency determining portions of the circuit should be of the NPO type, as noted in Figure 6. Unless the NPO type is used, this will be another source of drift. In addition, when final trimming of the VFO frequency is done in final integration, you will need several more small value, NPO capacitors such as 1 pF, 2.2 pF, 4.7 pF and 10 pF. You may want to purchase several of each value. After building the LO, the remaining drift will be compensated using the temperature coefficient N1500 small trimmer in Figure 6.

Build the VFO in serial fashion starting with the BF998 oscillator and proceeding through the 2N3904 amplifier. You may also want to consider two optional modifications. If you are interested in 75/80M operation, you will need to provide for bypassing the frequency doubler circuit. This is accomplished with the two headers and jumper pins shown in Figure 6. You will also need to make similar modifications to the receiver front end tuning network and 40M Band Pass Filter to be discussed later. The second modification concerns the optional 100 ohm potentiometer in the 2N3904 emitter circuit. This circuit element allows later experimentation if changes are made to the DC receiver board. If you think you will not want to make experiments of this type, replace the potentiometer with a 50-ohm resistor connected in parallel with a 10 nF capacitor, which are then connected directly to the emitter of the 2N3904 on one end and to ground on the other end as shown.

Once the LO is built, you will need either a ham band receiver tuned to 75M or a frequency counter to listen for or detect the presence of RF. While use of the RF probe will show output, it is not useful for telling you the current frequency and range of the VTO. The test process is as follows: listen for the signal in the range 3.5 to 4.0 MHz on the receiver or, if you are using a frequency counter, connect it to point A on the schematic shown in Figure 6. Once found, then connect the frequency counter to Point Z and look for the signal at 2x the VTO frequencies. If you can hear the 7 MHz signal and vary the frequency over 80 to 120 kHz, then this set of tests is considered complete. Later when the LO is connected to the Direct Conversion receiver, we will adjust the range and set the frequency limits correctly. Drift tests will also be made to determine what corrections need to be made to compensate for any drift.

The 40M Band Pass Filter is the last item to be built. It is relatively simple to build containing seven capacitors and two inductors. The Schematic is shown in Figure 9 and the completed unit in Figure 10. The 0-3 pF trimmer cap can be found at All Electronics and all other capacitors come from Mouser. The T-68-6 toroids were selected because this is a standard value used in a W7ZOI tutorial on filters. Everything else comes from the calculations. If you are interested in 75/80M operation, then the optional header pins and shorting plugs will be needed; otherwise, they may be omitted. When a shorting jumper is on pins 1 & 2 the filter is in line for 40M operation. When the jumper pin is moved to pins 2 & 3 the filter is bypassed for 75/80M. I used the copper square

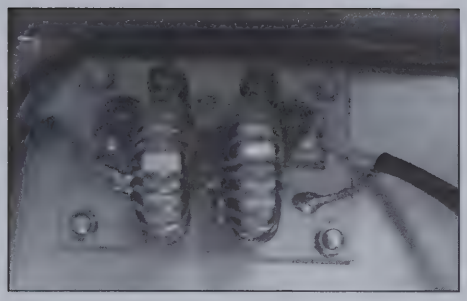

Figure 10—Bandpass filter photo.

method again because it can be mounted directly to the base plate. The single side copper vector board can also be effectively used here as no pads need to be cut.

Use the test oscillator for a quick alignment by inserting a signal at the input of the filter and temporarily connect a 50-ohm resistor across the output. Place your RF probe and digital voltmeter across the output and tune for "max smoke". This is a rough alignment and will get you in the ballpark. If you are unable to get a peak reading, then check for wiring errors, shorts, solder bridges etc. A relative peak reading should be evident! We now are ready to mate the LO with the band pass filter and do more testing. Leave the 50-ohm resistor in place. If you have access to an oscilloscope, place its probe on the filter output; if not, use the RF probe and voltmeter. Power up the LO and observe the readings as you tune the LO through its range. Jot down the readings and you can plot the shape of the curve. What you are looking for is a flat level of output over the range of the VTO with output falling off at the ends of the range. Adjusting the trimmers will materially affect the shape of this curve. A few times through this process and you should have something usable.

The Final Integration

We are now ready for the final integration of the three boards. There are four parts to the final integration:

- Hook up of the three units and a 40M antenna
- Basic tune up of the input network and adjusting levels
- Drift corrections
- Final install in your enclosure of choice

I recommend staging the final integration on a piece of 1/2-inch plywood. This will give you more room to work and make life easier if you have to work on one of the boards. A 12" x 12" board should give you plenty of room. Place a couple of 5-lug terminal strips at the center of the board for power and other interconnections. Now place each board flat against the plywood and drill a hole at the opposite corners of each PC board. If you used vector board construction, drill each hole completely through the board using a drill large enough to pass a 4-40 machine screw. If you used PC board construction, then use a drill to provide a pilot hole for a #4 wood screw. PC board construction can be laid flat to the plywood and held by the wood screws. If you constructed the receiver using vector boards, then you will need to elevate the boards using 1/2-inch aluminum pillars tapped for a 4-40 screw on each end. A flathead 3/4" long machine screw should be passed through the plywood from the bottom, connecting to the aluminum pillar. The plywood should be soft enough so that the machine screw head can be countersunk in the plywood. This allows the plywood bottom to present a flat surface. If you have a hard time picturing how this works, consult Figure 17 of Reference 1 for an example.

Before proceeding further, I need to say a word about power sources. DC receivers are susceptible to power supply hum, owing to the large amount of gain at audio frequencies. As an aside, DC receivers are also susceptible to "microphonics", audible responses in the receiver when a board is tapped with a small instrument. But, that is just part of the fun of these little radios. If you are using a regular station power supply, I recommend a ferrite filter made by wrapping the primary power feedline through a ferrite core. A couple of turns should be sufficient. In my case, I used a BN-43 one-inch binocular type core and the hum is barely noticeable. Alternatively, you can use a 12-Volt gel cell and a ferrite filter will probably not be required. If you use a battery, the receiver should operate well down to about 10 V. At lower voltages, the 8 V regulator for the LO may not operate properly.

Once each module is mounted, power it up individually before connecting to the other modules. Then, perform the test procedures used before to check out the module. Take your time as you have worked very hard to get to this point and the last thing you want to do is smoke a DGM or burn up a board. Check all your wiring and insure nothing has been compromised. Look for the usual culprits: shorts in the wiring, solder bridges, components improperly installed. Once all is working, power everything down and make the necessary interconnections between modules. You will also need to provide temporary connections to an antenna and earphones or a speaker. Check all interconnections again to make sure they are correct. Also, hook up the test oscillator to the board. My on-off switch for the oscillator is to pull the crystal out of its socket. Note that connections from the LO to the 40M Band Pass filter and from that filter to the Receiver board should be made with short lengths of RG-174-U coaxial cable.

Now for the moment of truth as you power on the radio and look for a signal. At the very least you should hear the signal from the test oscillator. If you hear only the test oscillator, check the 40M band with your station transceiver to see if signals are present. In some locations, the band can be fairly quite at times and you may want to consider doing this part of the integration later in the day. If even the test oscillator cannot be heard, then you must start a trouble shooting process. Start by powering down the breadboard and re-verify all of the inter-connections. Has power been applied to all circuits? Has a solder joint come loose? Has something been inadvertently shorted. Take your time with this process, as this is highest probability for the radio not working. Assuming you do this and verify all connections and no other issues then it is necessary to conduct a detailed trouble shooting process using a systems approach.

Do you hear sound from the speaker? No sound, then it is an audio amplifier problem. Sound but no signals received. Is the LO working? Go back through the LO test process. You hear signals but not the test signal. This has two possibilities, one being the test oscillator is not working. Use the test methods to determine the oscillator is working. The other possibility assuming the Oscillator IS working is that the LO range has shifted. Use the process described to verify the LO range. Another very important setting is that the signal from the LO to the receiver as controlled by the LO level potentiometer be set for maximum. Take the RF probe and touch

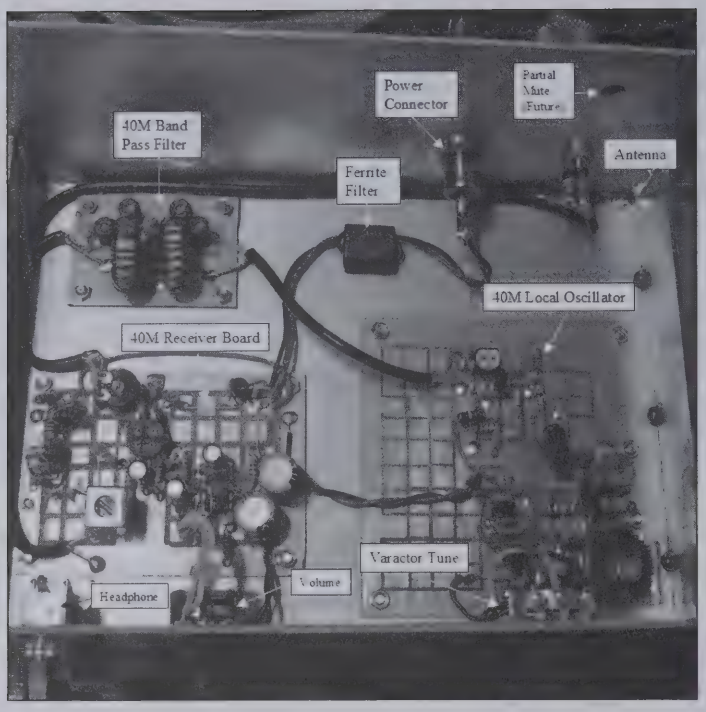

Figure 11—Overhead view of the completed receiver.

that to the center wiper of the potentiometer. Turn the potentiometer across its range and find the maximum signal. The final setting of LO power will be done later.

You have the radio working and now you need to calibrate the LO to cover the desired range. This is where a frequency counter and/or ham band receiver comes in handy. The VTO does radiate a bit of RF and you can use that to your advantage by placing the DC radio next to a ham band receiver. With a short wire acting as an antenna for the ham receiver, you should be able to hear the signal. By listening to the ham band receiver you will know the high and low end of the VTO and the frequency spread. If the spread is smaller than 100 kHz, substitute a smaller resistor for the 4.7 kohm resistor attached to the 10 kohm tuning potentiometer. If the range is larger than 100 kHz, substitute a larger resistor or add a much smaller value resistor in series with the 4.7 kohm resistor. You should be able to achieve a range of 100 kHz +/- 10%. Now we will set the low end frequency of the VTO. This is where having a few small value of capacitors comes in handy if you need to lower the frequency. Just add the small capacitors in parallel with C1 on the LO board. If you need to raise the frequency coverage, then there are a couple of tricks. One is to remove the 18 pF NPO unit specified as part of C1 and replace it with three or four NPO capacitors in parallel whose total value is less than 18 pF. Actually there is a popular belief that such a replacement actually makes a circuit more stable. Since all of the current in the circuit (read heating effect) is being shared by several capacitors, there is less of a tendency to have heat related drift. A second approach is to loosen the screw from the plexiglass plate over the inductor and slightly spread the turns of the inductor. Tighten the screw and measure the frequency.

Once this is done it is time to make some drift measurements. This will require some time and tweaking to get your LO to settle down, but once set it shouldn't change. Here is where our test oscillator comes back into play. Hook up the oscillator and let it and the radio stabilize for about 10 minutes or so. Then tune to "Zero Beat" on the test signal. Leave the receiver on this frequency for about a 15-minute period. Come back and listen to the signal—is it still at Zero Beat? If it is, immediately go out and buy as many lottery tickets as you can afford for this is indeed your lucky day!!! Very likely it will not be at Zero Beat. Now you need to find out how much did it drift and in what direction. You may need to do this several times but you will eventually see the amount of drift and in what direction. Rotate the N1500 trimmer (meaning a negative drift of 1500 Parts per million) a small amount. Tune back to zero beat and leave the receiver for another 15 minutes. If the amount of drift is larger, rotate in the other direction. If no trimmer setting will give you an acceptable drift rate, then you probably need a positive drift coefficient capacitor. You can find these trimmers at Mouser.

Earlier, I described the process for setting up the 40M Band Pass Filter. You may need to retouch those settings a bit in an attempt to reach a flat band pass across the frequencies of interest. If so, now is the time.

Next we will look at setting the LO pot level on the Receiver board. It may not require the full level. If so, it will be evident on strong signals that the DGM is being overloaded. About 1 volt Peak to Peak on G2 is about the optimum level. Finally, tweak the Input network so that mid-band 40M signals are being peaked.

With all that done, now it is time to move the boards into the enclosure. Figure 11 is an overhead view of my enclosure. It is a suggested way but not the only way to do it. That said, there is nothing wrong with leaving it on the breadboard. Hey, in the early days of ham radio all circuits were home built "al fresco."

Finally, we just need to calibrate the receiver frequency. You can see from Figure 1 how I did it. I found the metal dial plate in my "junque box." The arbitrary 0-10 numbering on the dial plate is correlated to the actual frequency by the frequency chart on the left side of the receiver face. If you are not lucky enough to find a similar plate at a hamfest, there are various software programs that can be used to make a paper version. Alternatively, you could draw a circle of the proper size with a compass on paper. Spread the 0-10 markings evenly over about 320 degrees. Using your ham band receiver, measure the frequency at each one of the dial locations. Then using a spreadsheet or hand drawn chart, create a plot of the dial marking and the frequency readout. Most office supply houses have laminating capabilities and can laminate your paper dial and chart for protection.

Final Comments

This was a most interesting project and Part II will cover the mating transmitter. I have really enjoyed working on this project and it has opened my eyes to the many possibilities of using Dual Gate MOSFETS. The other day I was "noodling" over the possible design of an SSB transceiver using nothing but Dual Gate MOSFETS. Stay tuned!

—73, Pete N6QW

Reference

1. Juliano, Pete. "JABOM — A 17 Meter QRP SSB Transceiver: Part 1", *QRP Quarterly*, Summer 2011 issue.

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QRP Field Day Tips and Techniques

Russ Behm—K6RHB

Jim (N6MBY) and myself (K6RHB) have refined QRP operations during several Field Days—actually, too many to count. Herein are some operating notes that guarantee to make you a better QRP operator or form the basis for your own ideas. With the information herein, we have earned first place in the 2B category one year and actually made one contact with 1/8 watt. I hope these suggestions are helpful—Good Luck with your QRP Field Day 2012 plans!

Figure 1—Multi-band trap dipole for 20M, 15M, and 10M

Antennas

We use primarily simple dipoles. Placement potentially resulting in mutual coupling has not been a problem. We use tree branches for end supports and a throwing pulley with cord for mounting. If your throwing location has pine needles, a tarp overlaying the ground can hold the unwound cord so as to avoid snags.

I found an old fish stringer with giant safety pins that we use for quickly connecting the dipole ends to the throwing line. This saves a lot of time. The fish stringer can be found in any sporting goods store.

The SWR is adjusted with a MFJ259 bridge, Vector Analyst VA-1, or a Bird wattmeter. Experiment with antenna height to yield the best SWR. You should be able to obtain 1.2:1.0 SWR. Tune for 7.2 and 3.8 for mid- position in the lower bands for phone.

We use a multi-band trap dipole antenna to save space and simplify station setup, but it is not a necessity as opposed to standard dipole antennas. We tried the 10M-15M-20M vertical shown in Figure 2 this year with 100-fold signal improvement for only one contact that was vertically polarized. So it does not justify the effort for future years.

We tried an E/W-N/S 40M dipole pair one year, but as the antenna books mention there was no perceptible signal difference. Remember that these low dipoles are basically omni-directional.

For transmission lines, 75 ohms works best for 40 meters dipole, while the other antennas work best at 50 ohms. (Next year's experiment will be to insert an adjustable matching transformer in the feed line to improve the 1.2:1 SWR to the 1:1 performance of the 80 meter dipole.)

Power Source

A solar panel and gel cells make an ideal power source for a QRP station. I use a 16-watt panel and approximately 12 amp-hour gel cell. That size cell has always stayed charged enough for extended periods of darkness when 80M is open. The solar panel is repositioned during the day to track the sun. Jim uses an amp meter to monitor output from his solar panel; however, it is not completely necessary.

I connect the solar panel directly to the gel cell without a charge controller. Expect 16 volts from the panel as it charges the gel cells without a controller. For the purist, Morning Star makes a ProStar 15 charge controller designed specifically for controlling the charging of gel cells. It will limit the charging voltage to approximately 13.2 volts.

Radios

This year was highly unusual with 2 of our stable of radios failing, but the contest went on OK with the Swan and White Mountain 40M rigs.

Jim uses his Swan SS-15 (Figure 3) with power set down to 5 watts. The SS-15 can be found on eBay.

I typically use a Ten-Tec 515 (Figure 4) with output power of 4 watts. The Ten-Tec 515 can still be found on eBay. Be ready to pay premium price for a rig in average to good condition. I have also used a White Mountain 40M rig (Figure 5), rated at 2 watts. I added a miniature 20-turn control to make tuning easier. It works great with that control! These rigs are no longer available from Small Wonder Labs. But, there is a replacement series called SW+ which is quite similar in capabilities.

A current generation QRP radio for your consideration is the Yaesu FT-8 17. It

Figure 2—Multi-band vertical for 20M, 15M, and 10M.

Figure 3—Swan SS-15 QRP transceiver preferred by N6MBY.

carries its own batteries. It also serves double duty as a back packing radio due to its small size and would make a welcomed addition to the stable of radios.

Accessories

A cassette recorder to copy the CW Field Day Message on Saturday morning is handy. A night-light for evening and predawn operations is a necessity.

An output power attenuator allows power to be set to less that 1 watt. This creates your own challenge when contacting those powerhouse stations. As mentioned earlier, I contacted one station with 1/8 watt with the homemade attenuator in Figure 6. The design is from the ARRL handbook. I used the pi-section resistor values; however, the T-section should work just as well as long as the resistor values can be found.

A wattmeter is handy to verify output power. I use the WM-2 in Figure 7 with the most sensitive scale being 100 milliwatts. The WM-2 is still available in kit form from OHR.com. I added a LED pilot light as an aid to minimize the chance of discharging the internal battery. A Bird wattmeter would also do the job, but with less sensitivity, and should be available at your favorite swap meet.

A small dummy load is handy to allow for checking a rig's output power before the antennas are available. My dummy load, shown in Figure 8, has both a 5 watt 50 ohm and 75-ohm resistor in a small metal case.

A small plastic fishing tackle box is handy for storing miscellaneous items such as tools, jumper cables, connectors, fuses, and headphones. For this vintage of QRP radios, a small screwdriver set and Allen wrench set can be useful someday along with a wire cutter, pliers, and simple VOM for field repairs.

Logging Contacts

I log contacts on a large sheet of paper (11" x 17"). I leave room to record the power in use and provide space for any notes such as whether the contact is QRP also. Deduping is easy when each line is a separate entry. One sheet per band is adequate.

Typical Band Conditions

- When is 40M open? Daylight hours for short skip, nighttime for longer range.
- When is 80M open? After sunset, all night long till sunrise, best prior to sunrise on Sunday morning.
- When is 20/15/10 Open? During daylight hours.
- When is 6M open? Anytime is possible.

Easy Bonus Points

- Low power = 100 points
- Solar (natural) energy source 100 points
- Field Day Message = 100 if there is an active local net.
- Press Release = 100 points.

Creating a Press Release can be lots of fun and a chance to invite the public to check out the station. Do not be surprised if the press release is met with a yawn due

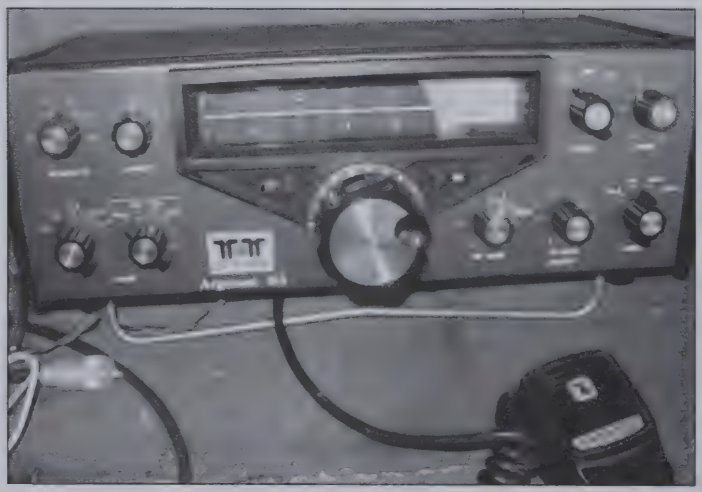

Figure 4—K6RHB uses a Ten-Tec 515 QRP transceiver.

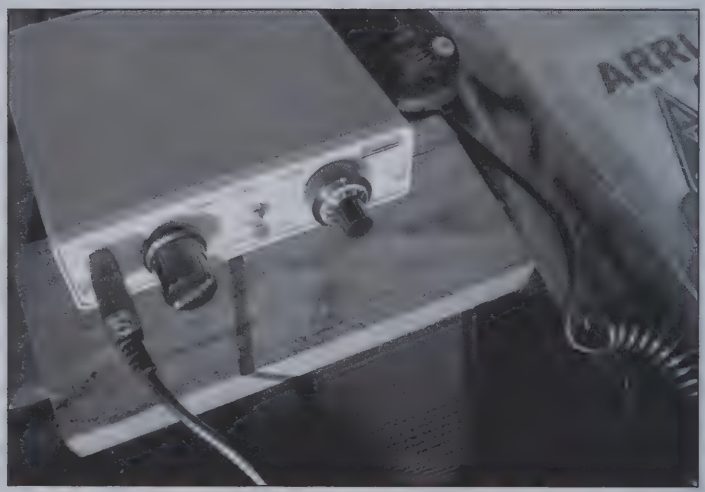

Figure 5—A White Mountain 40M QRP rig is also used.

Figure 6—A homemade power attenuator lets you set power at QRP levels.

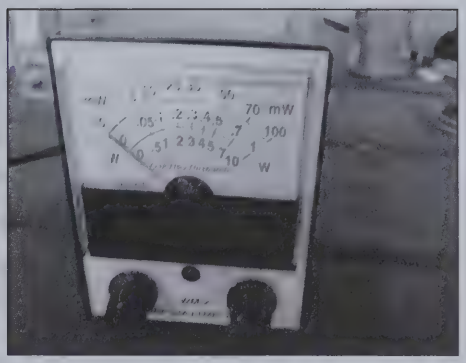

Figure 7—A WM-2 wattmeter keeps you under the "QRP legal limit."

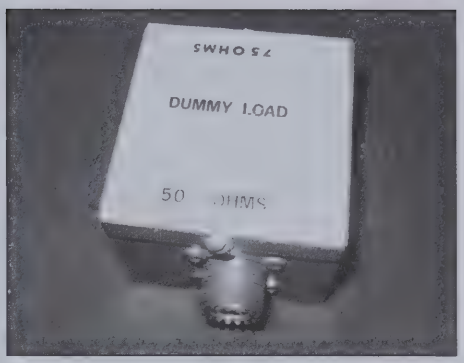

Figure 8—This is our dummy load for either 50 or 75 ohms.

to the advent of computers, cell phones, MPG players, iPods, and iPads. (I wonder if there are fewer Field Day participants as time goes by.)

Food and Drink

Meals: great to have a cook, otherwise cold sandwiches will have to do along with some candy bars.

Hot Weather Drinks: your favorite soda, Snapple.

[Sure are lots of options in the food and drink category, depending on your personal culinary preferences and prowess at the cookstove! —Ed.]

Weather's Influence

Storms across the nation should help to improve the total point score by at least one to two positions, thanks to Mother Nature and static electricity being on your side for Field Day!

About the Author

Russ Behm is a long-time ham with WB9ACS as his previous call sign. His current call is K6RHB and he lives in Santa Barbara, California. Russ enjoys making accessories in kit form or new homemade projects. He has participated in Field Day for several years along with his friend N6MBY and looks forward to Field Day each year.

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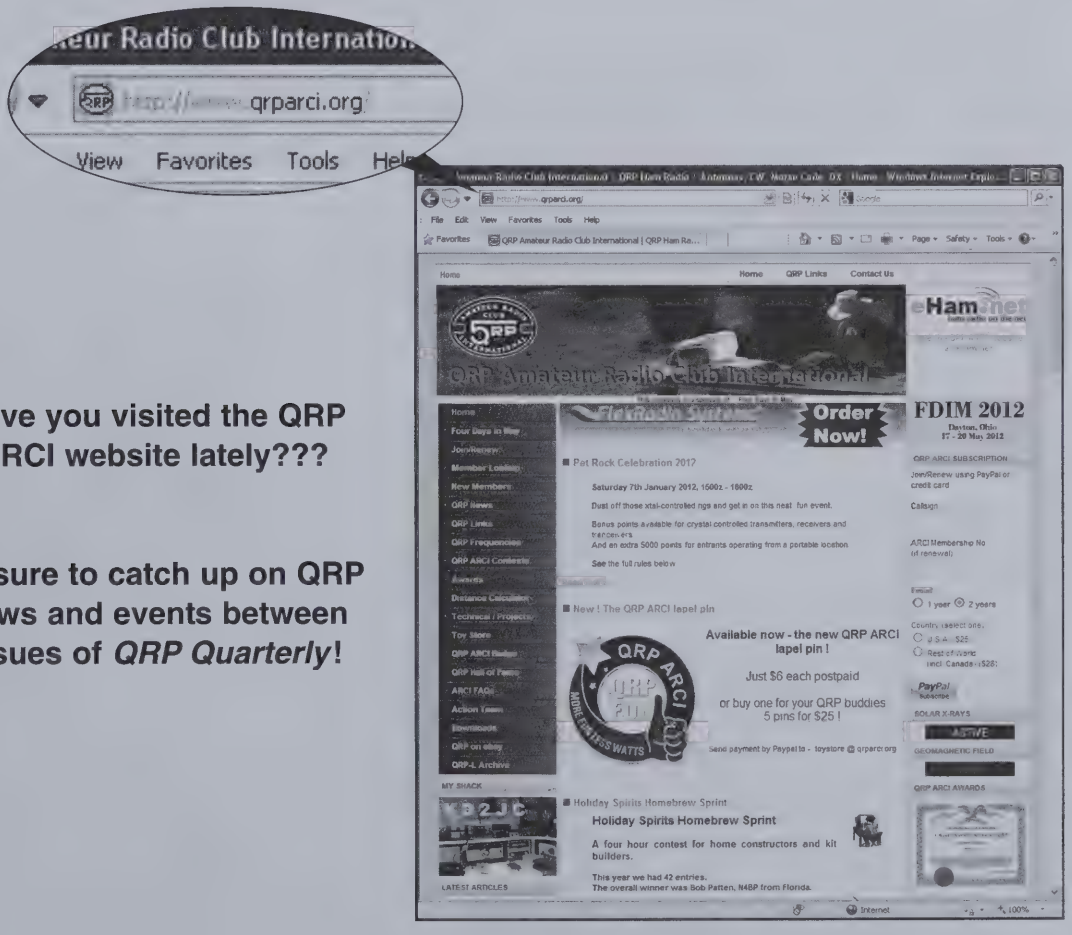


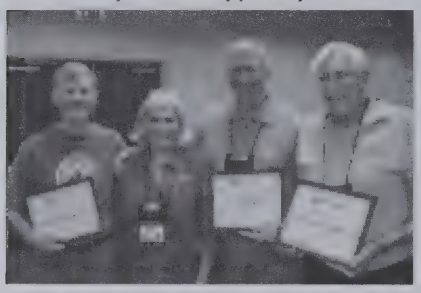
Have you visited the QRP ARCI website lately???

Be sure to catch up on QRP news and events between issues of *QRP Quarterly*!

FDIM

Four **D**ays **i**n **M**ay
May 17-20, 2012.
The ***Premier North American QRP event.***

Get it on your calendar now! Thursday-Sunday, May 17-20.



Another great FDIM is planned for this year. If it's your first or 17th, there will be something here for you. QRP-ARCI is sensitive to the first time attendee and will try to make your first FDIM as fun and interesting as possible. We will also have spouse/guest activities.

Registration and getting acquainted begins on Wednesday evening. Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell, vendor displays and plenty of time to swap tales and a cash bar for those that want it. Most of Friday daytime is open to attend the Hamvention® and visit the QRP-ARCI Toy Store. We'll have plenty of room at the hotel during the day for casual meetings and time to visit with old friends and make new ones. Friday evening activities usually include "show and tell", vendor displays and a judged home brew contest. And you'll find some FDIM specials from several vendors. Most of Saturday is again open for the Hamvention®, and we have a great social event, our annual banquet and awards presentation. There will be plenty of door prizes that evening. Sunday is the Hamvention®, and check-out.

We are gathering speakers for the seminar on Thursday. We promise another great selection with interesting topics. We'll have a "meet the speakers" social gathering after the seminar, where you'll have an opportunity to meet, question and discuss QRP with the speakers.

Don't miss out on the show and tell. You'll have an opportunity to bring out your QRP related projects and put them on display. Your contemporaries will have a chance to roam through the displays and see the excellent craftsmanship used in these special exhibits.

We'll have a judged homebrew contest and it shouldn't surprise you to find a fun contest or two during the weekend. We've had QLF, split paddle, RUFZ contests and other fun activities in the past.

QRP related Vendors are invited to exhibit both Thursday and Friday evenings. We're sure you'll find many special FDIM discounts.

The hotel is including breakfast with the price of the room. The hotel has been very accommodating and a pleasure to work with. You'll find fine dining as well as fast food restaurants across the street from the hotel. Dress is casual for all events.

We will again be at the

Holiday Inn, Fairborn, OH. Reservations and special room rates for FDIM are available through www.FDIM.QRPARCI.org. Remember, all discounted hotel rooms are released only through QRP-ARCI. Instructions will be posted as soon as the Hotel is ready to start processing our Room Block.

This is preliminary information. A complete schedule and list of activities will be posted on the web site as we move through the process.
Questions or comments should go to:fdim@qrparci.org,

Last updated
December 14, 2011

FDIM
Four Days in May
May 17—20, 2012

Thursday a full day of Seminars

Friday spend some time with vendors

Friday daytime, take a break or attend Hamvention

Wednesday evening Registration and get together

Friday Evening Vendor Night Judged Competition Home Brew Displays

Guest/Spouse Program

- Registration and getting acquainted begins Wednesday evening.
- Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell and plenty of time to swap tales during the evening. We have some special activities planned for Thursday afternoon.
- Friday daytime is open to attend the Hamvention® and visit the QRP- ARCI Toy Store. The hotel will supply some gathering space.
- Friday afternoon and evening activities usually include "show and tell", vendor displays and a judged home brew contest.
- Saturday is again open for the Hamvention. For the evening, and we have our great annual banquet, awards presentations and door prizes.
- Sunday is the Hamvention®, and check- out.

Saturday Evening Awards Banquet Door Prizes

Thursday Evening Meet the Speakers

Thursday Evening Casual Show and Tell

Thursday Afternoon TBD

Saturday Morning Off to Hamvention or see the sights

Much More! Watch the web site www.qrparci.org

FDIM Registration and Hotel Reservation on www.fdim.qrparci.org

Home Brew Contest	Door Prizes
Special Activites	Discounted Hotel Rooms
Banquet	Complimentary Breakfast
Seminars	Hamvention just across town
Meet the Speakers	Nearby Restaurants
Vendor Displays	New Product Announcements
Discounted QRP Products	Spouse Program

This is preliminary information. Some changes will most definitely occur.
Please check the web site, www.qrparci.org, for the latest details and registration information.

12.14.2011

A 5-Tube 20M QRP SSB Transceiver

Giovanni Berenati—IW9ARO hotwater@alice.it

Many homebuilt ham transceivers are constructed as a challenge to reach some goal such as miniaturization, or refusing to use any integrated circuit, or being powered by a lemon. This project has a similar inspiration: only tubes and diodes (no transistors or ICs at all). Looks easy? Let's try to do it with just 5 tubes, operating in true SSB, 5W transmission, and a superhetrodyne receiver decently driving a loudspeaker. This is not a theory project, but a real QRP transceiver to make real QSOs, and in fact it stands in my shack together with other radios I built or bought. Figure 1 is the result. Front panel is essential with the few controls needed. On the two sides of the chassis, a touch of style with the wooden finish. Overall dimensions are 225(D) x 130(W) x 45(H) mm for the chassis and 160(W) x 110(H) mm for the front panel. Because of its original concept and the good execution, this project has won the first prize of the homebuilt equipment competition at MADS 2006 edition in Italy.

Nevertheless, it is not an easy design and some skills, experience and instrumentation are needed to get it working. Bottom line, I hope you will like the ideas and solutions I used, and perhaps some of them will be re-used in your own tube-radio design. Don't forget that the high voltages around vacuum tubes CAN KILL, so take extreme care when working with them.

Figure 1—The finished transceiver.

Architecture Choices and Project Targets

To get the maximum possible from five tubes and a bunch of diodes, you cannot separate the receiver from the transmitter. Each tube will play a role in either mode, similarly to what is normally done with the SSB filter in all commercial SSB transceivers. And to keep tube count to a minimum, a wise choice of multi-function tubes (I.E. triode+pentode) has been exploited while still remaining in the range of easy-to-find tubes. A great simplification comes from the adoption of passive (diode) mixers because they are intrinsically reversible, making the two conversions from baseband to RF and vice-versa very straightforward.

Another important choice is the local oscillator (LO) generation. A really usable SSB transceiver must stay on frequency, and a stable VFO is a tough design by its own with tubes. So I made my life easier with a 9 MHz VXO, using CB crystals oscillating at the fundamental frequency. CB crystals are cheap and available in close-spaced frequencies, thus allowing the desired band coverage with the proper choice of IF. A "coarse tune" rotary selector chooses one out of twelve CB crystals (can be more or less), and a variable capacitor does the fine tuning within ±3 kHz.

From the choice of LO frequency, the resulting IF is required to be a non-standard (~5 MHz). So the SSB IF filter has to be designed, built and aligned from scratch. With stock 5.2428 MHz crystals I built a quite good 2 kHz BW ladder filter, whose characteristics are shown later on these pages.

Limitation of tube count also means limitation of output power, but luckily tubes are not transistors so we don't have to speak about milliwatts. With a simple design and one EL84, 10~15WPEP is an affordable target that nevertheless I have not been able to fully reach, mostly because of plate voltage limitations caused by the transformer I used from my junk box. But I'm happy with my 5W pure QRP, expecting DX contacts as good as my FT817 with a half-wave dipole does.

So, in summary, what I request of my 5 tubes is:

- True USB
- Covering the SSB portion of 20m ham band
- VXO with crystal selector and fine tuning +/– 3 kHz
- Superhet Receiver, sensitivity <0.2 uV
- Driving a loudspeaker, >0.5W
- Transmitter PEP power: >5W
- S-meter
- AGC
- No semiconductor components, with exception (sorry...) of diodes

After many trials and some architectural changes, the final configuration I reached is shown in Table 1.

Block Diagram

The block diagram of Figure 2 shows how the blocks are related and switched between RX and TX. All relays are shown in receive mode. To simplify, the power

COMPONENT	RX MODE	TX MODE	GAIN
EF80 pentode (6BX6)	RF RX Amplifier	PA driver TX	~32 dB
EBF83 pentode+diode (6DR8)	IF RX Amplifier + AGC detector	IF TX Amplifier	~35 dB
ECF80 triode+pentode (6BL8)	AF preamp + AGC buffer	mic amplifier + modulator buffer	Av~150
EL84 pentode (6BQ5)	Audio PA	RF PA	~30 dB
6BK7A dual triode	Local VXO + BFO		N/A
Homebuilt dual balanced diode mixer	RF to IF downconverter	IF to RF upconverter	N/A
Homebuilt dual balanced diode mixer	Product demodulator	Product modulator	N/A
Homebuilt 4-pole ladder filter	SSB IF filter, 5.2425 MHz ±1.1 kHz (–6 dB)		N/A

Table 1—Transceiver configuration, major components.

supply section is omitted. Each block works in both RX and TX, therefore many switches are needed to reverse the signal path from antenna to audio and vice-versa. Three relays, for a total of eight switches, are simultaneously driven by the PTT switch on the microphone. Even with this "reversible" architecture, it's still possible to recognize a quite plain single conversion SSB receiver/transmitter. The heavy work is done by the tubes: just a four stage lineup is capable of about 140 dB total gain from antenna to speaker. A similar result would need at least 10~12 transistors, just for the signal amplification chain.

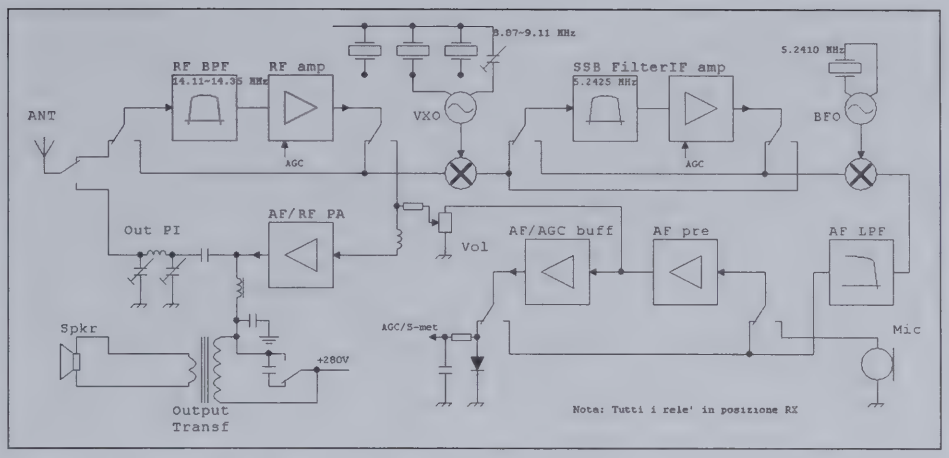


Figure 2—Transceiver block diagram.

Reversibility of various stages requires a certain uniformity of drive and load impedances at their ports. Wideband and narrowband impedance transformers have been used to unify impedances to a relatively small value (300~400 ohms, excluding the ports that connect to the antenna). This low impedance works well with the SSB ladder filter and the diode mixers. It also helps to avoid self-oscillations of gain blocks due to parasitic capacitive coupling between relays sections. Not all stages should be "flipped" to work in both receive and transmit modes. As said before, diode mixers are intrinsically bidirectional so they don't need to be "reversed," at the price of some conversion losses. Furthermore, they have enough dynamic range to handle the weak signals at reception and the large ones at transmission. Each oscillator output (the VXO and the BFO) is permanently connected to the LO ports of respective mixer and, by design, there will be no shift between RX and TX operating frequency.

The receiver has a simple AGC circuit that will be better described later. The AGC voltage and the S-meter drive current are obtained by rectifying the low-impedance audio at the output of the cathode-follower labeled AF/AGC buff. During transmission, the same buffer drives the AF side of the balanced modulator, which is a low-impedance port. Similarly, the AF signal section that amplifies the detected audio in RX works as a microphone amplifier in TX.

Quite uncommon is the configuration that allows the EL84 pentode to play the dual role of AF PA and RF PA with a limited use of relays. The signal to the grid G1 can be either AF from the audio preamplifier or the RF from the driver, and the plate load is made by two transformers in series. During TX, the output audio transformer is shorted and during RX the RF transformer is a short by itself for the audio signal.

Schematic Description

The complete schematic, shown here in Figure 3, including the high voltage supply section, but omitting the low-voltage supply needed to drive the relays coils. I've

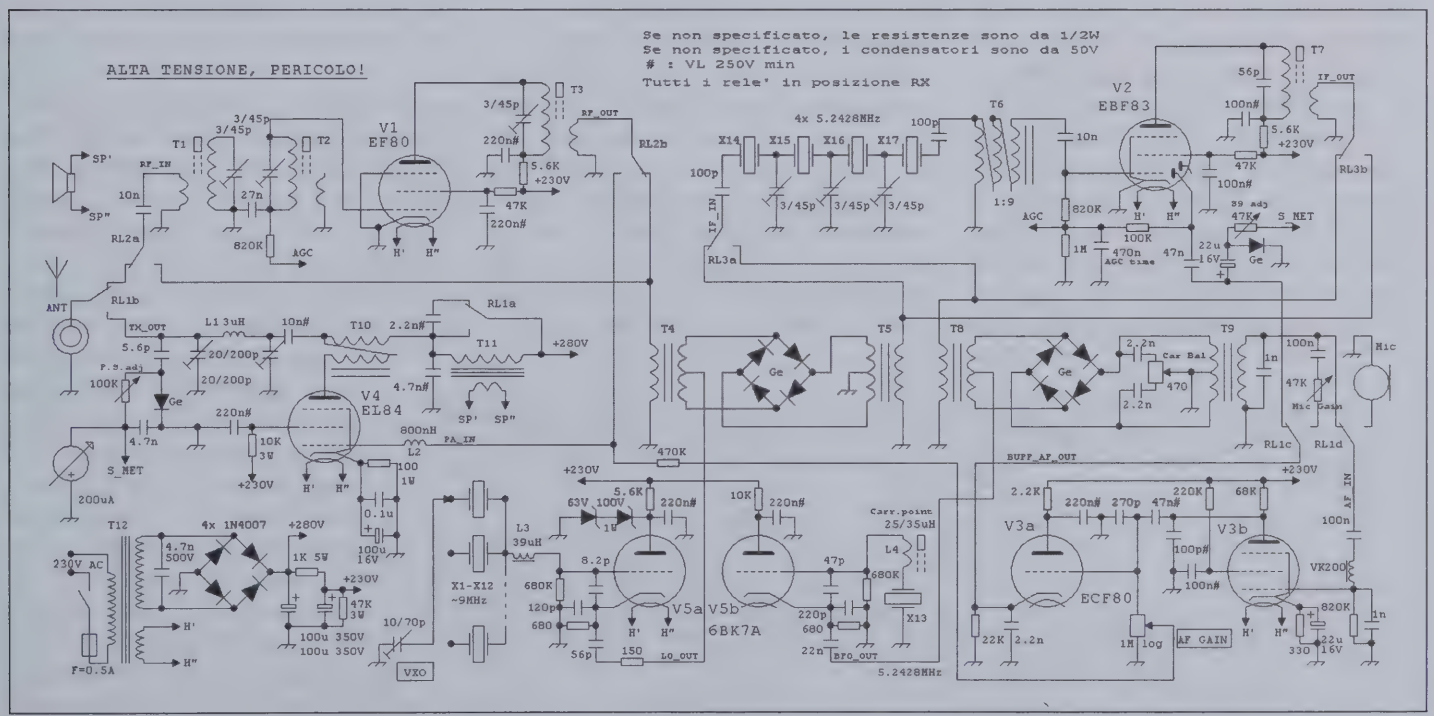


Figure 3—Transceiver circuit diagram.

L1	3 uH, airwound
L2	800 nH, ferrite core, adjustable
L3	39 uH, ferrite core
L4	25 to 35 uH, ferrite core, adjustable
T1	26/3 turns, 4 mm dia, ferrite core, adjustable
T2	=T1
T3	23/5 turns, 5 mm dia, ferrite core, adjustable
T4	13 turns, trifilar, 7 mm dia toroid
T5	=T4
T6	=T4
T7	55/10 turns, 5 mm dia, ferrite core, adjustable
T8	5 turns, trifilar, binocular 14 x 8 x 8 mm
T9	miniature audio push-pull driver transformer
T10	5 turns, bifilar, binocular 14 x 14 x 8 mm
T11	Output audio transformer for 6V6
T12	60VA/200V, 200 mA and +6.3V, 2A

Table 2—Special parts list.

used a voltage doubler from the 6.3 VAC of the tube heaters because I chose 12V relays. All relays are again shown in receive position. For a better understanding, I will split the circuit description in the two possible configurations (RX, TX) using two simplified diagrams.

Table 2 lists the special parts (coils and transformers) used in the transceiver.

Circuit Analysis in RX mode

You can refer to the complete schematic or to the simplified diagram of Figure 4, which shows only the signal processing during reception. The circuit is quite straightforward, but I will give some details here that will be useful also for transmitting operation. The signal from the antenna, filtered by the bandpass made by inductive coupled T1 and T2, is fed to V1 grid1. Impedance is raised to about 4 kohm for impedance matching. The amplified signal (~32 dB) on the plate is then reduced to 300~400 ohms by the resonant transformer T3 and fed to the downconversion circuitry. Figures 5 and 6 are the 3 dB bandwidth and full response plots of the RF stage.

The passive mixer is homebuilt, using Germanium diodes and tiny toroids (T4, T5). Its conversion loss is 2 dB better than a commercial wide-band one (like EMT-4) at this low frequency, probably because of Ge diodes vs. Schottky.

LO generation, as described before, is a VXO Clapp Oscillator, working at the fundamental series-resonant frequency of CB crystals. The triode chosen, after some trials, is 1/2 of a 6BK7A (V5a), which has given the best output amplitude and VXO span comparing to other triodes from my small stock (12AX7, ECC82). Many, but not all, of the twenty CB crystals I found in my junkbox can span ±3 kHz, so don't rely too much on this value. The worst-case to maintain the oscillation is when the variable capacitor is at the minimum value, thus a parallel trimming capacitor could be necessary to stay away from too low a value. I've experimented that the VXO oscillator should be in some way buffered to avoid residual FM and the pulling effect that offsets the frequency between RX and TX. The cause resides in the variations of load impedance offered by the mixer LO port. Having no room for a buffer tube, I managed to remove both problems by loosening the coupling of the oscillator output to the mixer. From 3 Vpp on the V5a cathode, the amplitude drops to 1.2 Vpp, which is still enough drive for the mixer. As an extra care, plate voltage is stabilized at 160V by a series of two zener diodes.

The 5.2425MHz IF is filtered by the homebuilt, 4-pole ladder filter whose response is shown in Figure 7. Five poles or more would be better for USB, but I had only 5 crystals in my hand, and one was needed for the BFO, so take it or leave it... Instead of making calculations of fixed capacitors for the filter, I've tuned the filter using an HP 8753A VNA to get the best possible results from it. Many designers do not take this important tuning step and underestimate the difficulty in making a good SSB filter, even proposing simpler/worse filters because the "on the air" result is still considered acceptable. As visible in the frequency response plots (and as described in literature...) the two skirts are asymmetrical, demonstrating that ladder design better suits LSB filtering (or whenever the rightmost side is used). Unwanted sideband rejection is –20 dB at around 300 Hz modulating audio, and –36 dB around 2 kHz (would be respectively –35 and –50 dB if it was used as an LSB filter or with an LO – RF = IF conversion scheme). Ripple is quite large: 5 dB peak-to peak, but mostly due to the high first overshoot. Sure, this is not the best SSB filter for the purpose but it works and believe me, nobody could hear what a network analyzer sees.

Both filter ports have impedance around 400 ohms, therefore the wide-band transformer T6 (1:9) is needed to match the 4~5 kohm V2 input impedance. After amplification, the resonant transformer T7 brings the impedance back to a lower value. Both V1 and V2 are variable-Mu pentodes, in order to be driven by the AGC voltage. (If the benefits of "variable-Mu" tubes are unfamiliar, see older editions of the *ARRL Handbook*, e.g. 1960's.) Therefore, their plate loads are resonant transformers to

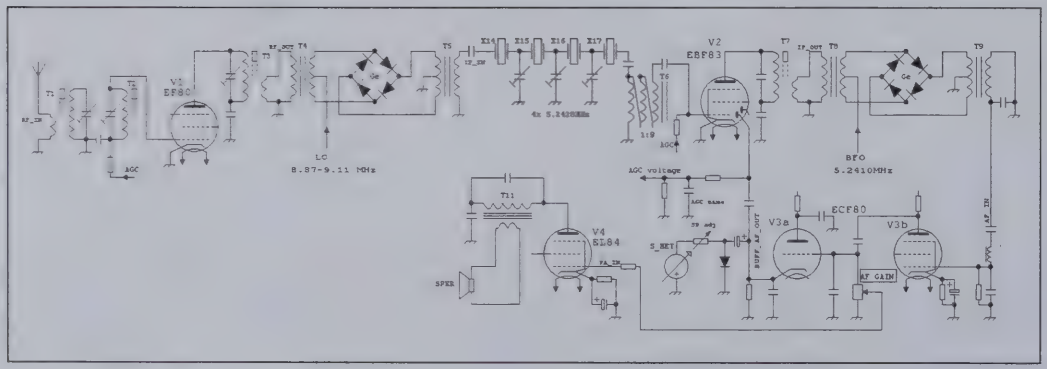


Figure 4—Simplified circuit digram for receive mode.

eliminate the harmonic distortion that those pentodes introduce. After some tests, the EBF83 has been preferred to the EBF80 because of the slightly higher gain. Overall IF stage gain, including filter and transformers losses, is around 27 dB.

The amplified IF signal is then fed to the product demodulator, another dual balanced diode mixer. This mixer is different from the downconversion mixer, because the baseband-side transformer T9 is an audio transformer (a push-pull driver) taken from an old AM transistor radio. To achieve a good mixer balance, I successfully experimented with a simple solution using one resistive trimmer and two capacitors. The BFO, built around the triode V5b, is almost identical to the VXO, but runs at fixed frequency with a 5.2428 crystal. Carrier injection point has to be adjusted by L4 at 5.2410 MHz +/– 200 Hz.

Well, finally we gotten to the audio baseband, starting from a weak SSB signal at the antenna connector. We have used just three tubes so far, so we still have two tubes in the budget to complete the project with AGC, S-meter and speaker audio. This assumes, of course, that we can use our same five tubes in transmit mode.

Generally, the AGC voltage is generated by rectifying the amplified IF signal, but here the sum of RF+IF gain is not enough to get the –10V we need for full AGC. Another option, more suitable for this project, is to rectify the amplified AF. The pentode V3b, with a voltage gain ~150, amplifies the AF from the demodulator to feed simultaneously the volume potentiometer and the grid of the triode V3a, configured as a cathode follower. The cathode follower is not strictly needed to drive the high resistance AGC line or the audio chain. But having a relatively low output impedance (~1/1000 of V3b output), it can be used to drive the low resistance coil of an S-meter. The same audio buffer, during transmission, works well to drive the low-impedance port of the balanced modulator. So we would need it anyway.

AF rectification is done in two ways: a Germanium diode for the S-Meter and a tube diode embedded in V2 for the AGC. Originally, the idea was to use the diodes in V2 for both purposes, but I learned that their high resistance (tens of Kohm) is unsuitable to drive a 200 uA FS microammeter. AGC times I found comfortable are about 40 ms (attack) and 500 ms (decay) with the component shown. It is possible to modify them by playing with R*C values, but not independently, so a trade-off has been chosen.

Being a simple AGC circuit without a dedicated amplifier, the AGC curve is quite "soft," as you can see in Figure 8. It has no well defined threshold (somewhere around 5~10uV) and a weak limiting effect. After the AGC threshold is reached, an 80 dB increment at the antenna translates into 20 dB at the speaker. Nevertheless, there are no saturation effects because all blocks in the signal processing chain can handle very large signals (they all work in TX, too), and the only drawback is the frequent use of the volume control.

After the volume control we have the audio PA, operated by the power pentode V4 (EL84). The AF signals at its plate ignore the RF transformer T10 and go totally to the audio output transformer T11, and then to the loudspeaker. I also put a headphone jack in the front panel of my

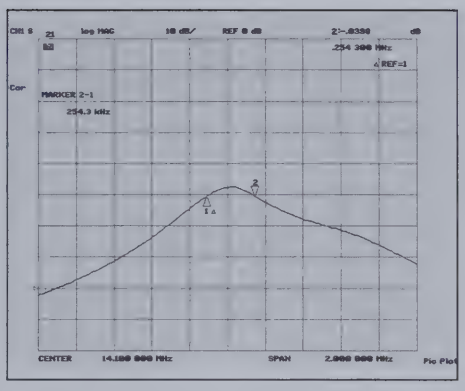


Figure 5—3 dB response of RF stage.

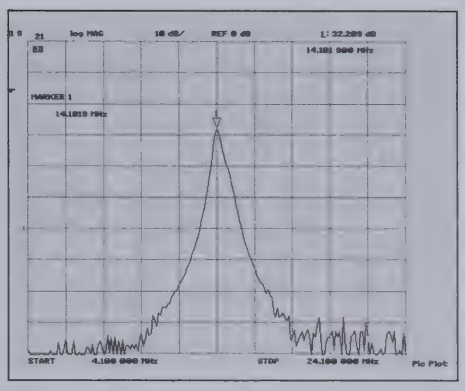


Figure 6—Full response of RF stage.

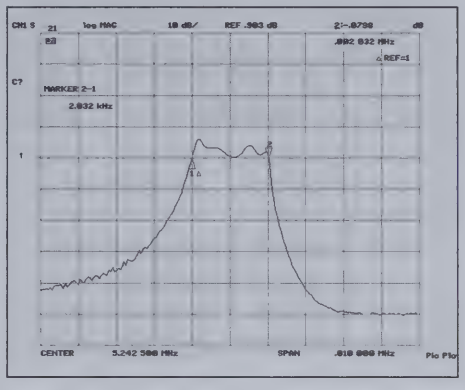


Figure 7—Frequency response of the homebrew IF filter.

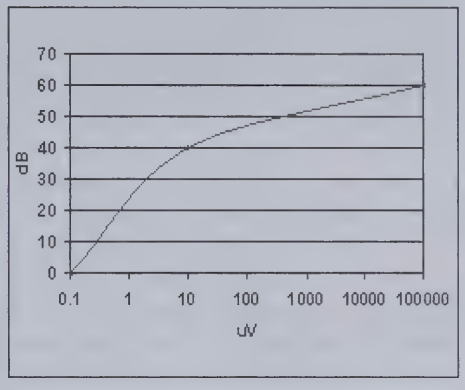


Figure 8—AGC response curve. The shallow slope means a "soft" response.

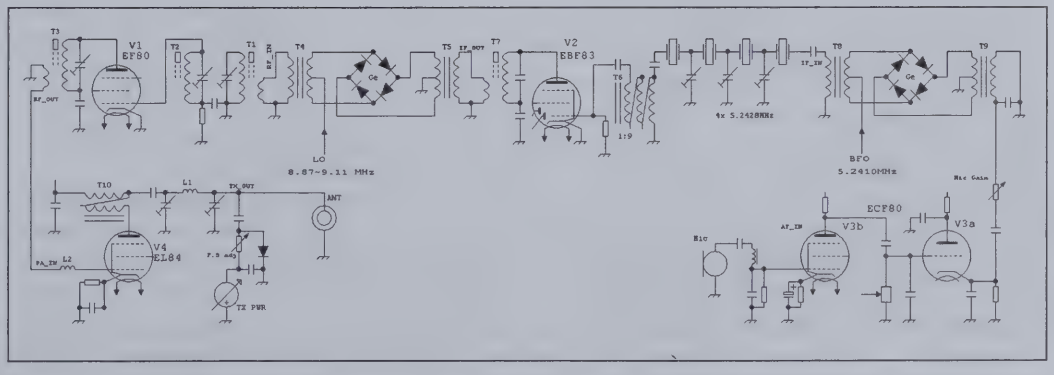


Figure 9—Simplified circuit diagram for transmit mode.

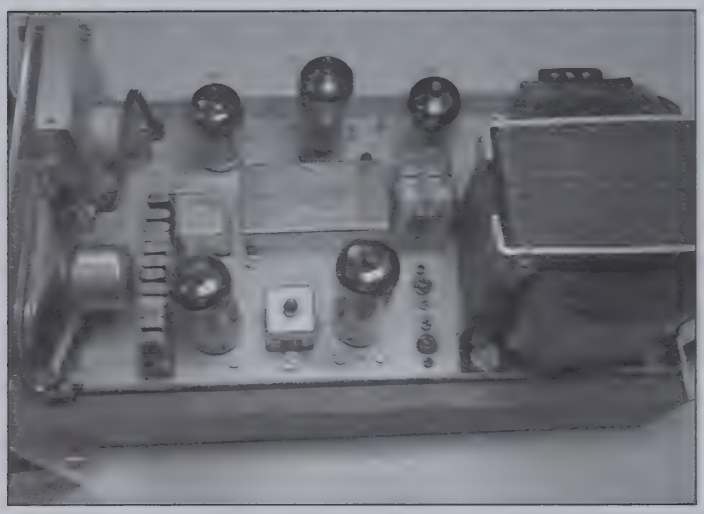


Figure 10—Top view of the completed transceiver.

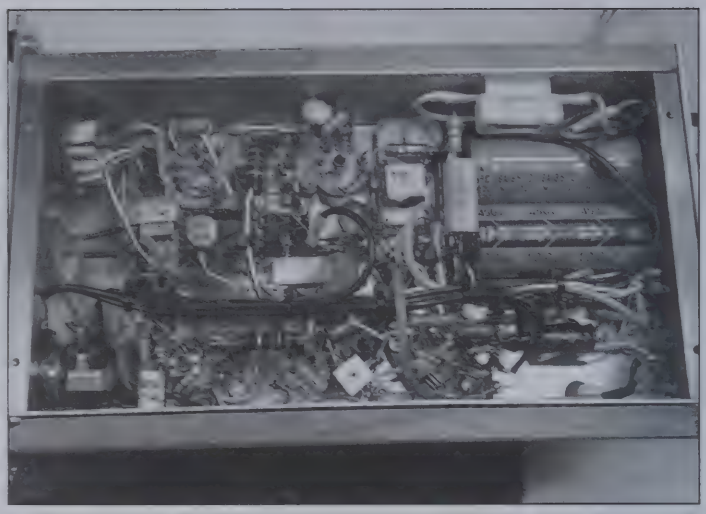


Figure 11—Bottom view of the transceiver.

prototype, not shown in the schematic.

OK, now the receiver is complete, but we have used all 5 tubes. So the question is: can we transmit with the same tubes?

Circuit Analysis in TX mode

It can be useful to refer also to the simplified schematic of Figure 9, where all blocks are shown as they are connected during transmission. Many considerations and details described in receive mode apply also to transmit, so I won't repeat them.

Starting from the microphone and going counter-clockwise, there is an RF blocking filter, then V3b amplifies the amplitude by 150 and feeds the cathode follower that drives at low impedance the balanced modulator. With the series trimmer I've been able to adjust modulation level appropriately for use with electret, piezo and dynamic microphones. The AGC detector is disconnected in this mode so that V1 and V2 will work at full gain. The unwanted LSB is filtered out and the SSB signal amplified by V2 to make it ready for upconversion to 14 MHz. The same RF bandpass filter used for the antenna signals is reused here to reject the unwanted mixing products. Yes, there is an impedance mismatch here, but I've verified that inserting a 1:9 transformer here doesn't improve anything.

The same V1 amplifies the modulated 14 MHz signal to be sent to the RF PA (V4) and then transmitted. V4 plate now has the audio transformer shorted, so the whole RF power is transferred by T10 to the classical PI filter. T10 works simultaneously as plate RF choke and as 1:4 wideband UnUn, thus operating a first impedance matching step to the antenna. The RF PA is an "A-class" amplifier, whose EL84 could be capable of 10~15W with an appropriate anodic supply. In my design I've achieved the 5 W_{PEP} minimum target, so I 'm quite happy. A simple RF detector monitors the output power using the S-meter microammeter.

RX OPERATION—

- Noise Floor: ~70 nV (–130 dBm) @ 3 dB S+N/N
- Sensitivity: 0.14 uV (–124 dBm) @ 10 dB S+N/N
- Blocking (ΔF = ±50 kHz): –46 dBm
- Blocking (ΔF = ±10 kHz): –50 dBm
- 3rd order IMD (ΔF = ±25 kHz): –66 dBm
- 3rd order IMD (ΔF = ±100 kHz): –66 dBm
- IMD dynamic range: 64 dB
- Calculated IPC (ARRL method): –34 dBm
- 2nd order IMD (8 + 6 = 14 MHz): –26 dBm
- 2nd order IMD (22 – 8 = 14 MHz): –16 dBm
- IF rejection: 92 dB
- Image rejection: 96 dB
- S9 reading: 50 uV

TX OPERATION—

- Power: 5.5W PEP
- Carrier suppression: >33 dB
- 2nd harmonic: ~40 dB below fundamental
- 3rd harmonic : >50 dB below fundamental
- NOTE: tests as described in *RadioKitElettronica* 5/99

Table 3—Performance test results.

Construction

As tradition rules, amateur tube equipments are built by point-to-point wiring with components directly soldered to tube sockets pins and to insulated supports. My transceiver is no exception, as you can see in Figures 10 and 11. The chassis is open, with the tubes visible. On the top of the chassis there are mounted the supply transformer, the audio output transformer, one of the relays, one tunable RF transformer and two submodules. The square submodule close to the crystal set is the 1st mixer, while the rectangular one in the center contains the RF filter together with the SSB filter.

Test Results (see Table 3)

On the Air and Conclusions

I've been pleased to make some DX with this radio (not many: I prefer to spend my time in my lab), mainly to test its operating capability. It's a QRP, so it's not a breeze. With a 1/2 wave dipole antenna, I made contacts from South Italy with north Europe, Spain and (my record) with Brazil. So the conclusion is: it works! ●●

QRP Clubhouse

Timothy Stabler—WB9NLZ wb9nlz@yahoo.com

Hello to everybody. I am assuming everyone has a pile of project to work on during the snowy months. Yes, I live in Northwestern Indiana and have to put up with "snow belt" white stuff until warmer weather appears. If you do not have this problem, I am a little bit jealous. Anyhow, I hope everyone has read the Fall editorial. Yes, with this issue, I am the new editor and am looking for write-ups (articles) of your latest projects. As your columnist, I still enjoy hearing what the various clubs are up to these days, so keep sending me your club (or group) info.

Figure 1—Central Florida QRP Group.

Ozarkcon:

My first comments are about Ozarkcon, which will be held this year April 13-14. The meeting is sponsored by the 4 State QRP Group (4SQRP) and is held in Branson, MO. This is an excellent get-together as well as an excellent learning experience. Last year, the building session held Friday night was building the "Ham Can" minimalist transceiver, designed by David Cripe, NMØS. Saturday is the day for the speakers to talk about their specialty. This past meeting, Jim Kortge, K8IQY, talked of the SS-40 receiver he had designed for the 4SQRP Group to offer as a kit. He had designed this receiver to go with the group's NS-40 transmitter. An interesting aspect is that the hotel, the Stone Castle Hotel, offers people who come to the meeting, the opportunity to stay 5 extra nights at the meeting rate.

The group sets up a station, KØN, that attendees work with dummy load antennas. QSL cards are exchanged. One is drawn for a prize. Vendors set up Friday afternoon and are there all day Saturday. Various projects are set up and voted on as the best in each category. including the "Wacky Key" contest. You might remember that two years ago, the winner was a potato-carrot assembly.

If you might be interested in attending or just want to see what will be going on, check out the website at www.ozarkcon.com. If it is not up at this time, give it a week or two. My write-up of this meeting will appear in the Summer issue.

Central Flordia QRP Group:

The Central Florida QRP Group continues their monthly outdoor operations on the second Saturday of the month. Details and contact info can be found posted on their blog at http://cflqrp.wordpress.com. QRP is growing a bit despite a very HOT summer that curtails some ops from going out into the great outdoors. Recently a small band of hearty souls in the Lakeland, FL area contacted the group and Jim K4AHO and Kelly K4UPG made the drive to meet up with them in a nice park and talk about getting together periodically to operate outdoors. They have also launched a blog at http://cfqrpgw.blogspot.com/ and have the start of a very fine group of QRP operators! The Group's next stop will be at the Melbourne Hamfest in October where they hope to put together a QRP meetup for lunch. There used to be an active group there that met weekly for outdoor ops but it has been idle for some time now. This Group hopes to reignite some interest in portable QRP over there on the Space Coast and do some outdoor ops with them in the future too. FOBB this year had at least 3 of their regular participants on the scoreboard and they operate in most of the QRP contests and nets as individuals. One area of growing interest is in activating islands in the US Islands group. Last year the Group activated their first island and they are actively searching out more islands in the Central Florida maze of rivers and lakes that they can activate. The Group (Figure 1) welcomes any and all modes and levels of operating experience to come out and join. Contact the Group via their blog or at CFLQRP@k4upg.com.

East Central Indiana QRP Group:

The East Central Indiana QRP Group (ECI-QRP) held a meeting October at the Maring Hunt Library in Muncie, IN. This was a unique meeting as the group stopped meeting about 5 years ago due to low attendance. Donnie Garret, WA9TGT, who is now retired, wanted to get the group going again and sent out email to those who had attended about a meeting he had set up.

Nine people showed up for what was a

Figure 2—Tony, KB9YIG talks about the SoftRock receiver kits.

Figure 3—WB9PLU's latest keys on display at the East Central Indiana QRP Group meeting.

very good meeting.

Tony Parks, KB9YIG, who designed the SoftRock 40, spoke on his kits and some changes he had put into place. He showed us his SoftRock Lite II receiver and passed it around. He then showed us his SoftRock RX Ensemble II receiver kit. He passed a completed kit around to be looked at and then, using pages he had passed out, pointed out directions for using the receiver on any amateur band using parts supplied in the kit. (Figure 2) He then did the same for his SoftRock 6m/4m/2m RX Ensemble kit. When asked about 4 meters, he told us that it was used in Europe. Parts and directions are included for band selection. Finally, he showed his SoftRock RXTX Ensemble transceiver kit. Again, parts and directions for band selection are included in the kit. At the end of his talk, a drawing was held for a SoftRock Lite II receiver kit. This was won by Neal Thompson, W9IGY. One comment should be added here. Tony, himself, orders in all parts for kits, puts them together and mails them out. This does take time.

After a short break, we went from one person to the next to talk about their latest project or whatever. One interesting talk was Richard Meiss, WB9LPU, who showed 4 of his latest keys (Figure 3) he had made. Perhaps the most interesting one was the one that could be operated in any position and included a strap to hold it onto your leg.

The Library had told Donnie about meeting times allowed so we had to leave in two hours. This year, meetings have been scheduled on April 7 and October 6, and are to last for 3 hours each (12 Noon-3PM). It is hoped more people will come. If you wish any further information about the meetings, please email either Donny (cfzepp@gmail.com) or myself (wb9nlz@yahoo.com).

Midwest Homebrewers and QRP Group:

On November 12th 2011, the Midwest HomeBrewers and QRP group celebrated the 7th Anniversary of the group (Figure 4). Wow, time really flies when you are having Fun!! And, seems no one remembered to bring a cake. Duh!

Several discussions were on the agenda, with the OzarkCon Friday night build being first. So, it is official, the Friday night build for the 2012 build will be the WBR high performance Regen receiver originally designed by N1BYT (Daniel Wissell) and published in *QST* January 2001

Here is the link to the build that Richard, AA7EE did, Dar (W9HZC) is laying out the prototype board with Manhattan pads trying to match Dave's layout as close as possible (Figure 5). Builders will be provided with board, pads and all parts at Branson.

http://aa7ee.wordpress.com/2011/07/24/the-wbr-a-simple-high-performance-regen-receiver-for-40m-by-n1byt/

Item two, Dar (W9HZC) brought in a tiny 27 MHz HT kit that he had ordered off the web. Several of the members have always wanted to build a little HT similar to the "FredBox" by G3XBM except we will re-design ours to be on 10 meter AM instead of 2 meters. The kit can be order from the following link. The kit actually comes with two complete tiny 27 MHz rigs and a matching case (or 2) can also be ordered from this source and is listed there with the HT kit.

Go to http://store.qkits.com/moreinfo.cfm/FK711. The HT kit is the FK711 and the case is the FB07. How about some low power 10 Meter DX everyone?

December was the first meeting of year 8. It seems like we started this just last week. We thank everyone for their support and ideas over the last 7 years.

There were nearly a dozen folks this past Saturday. The XYL of Darrel,

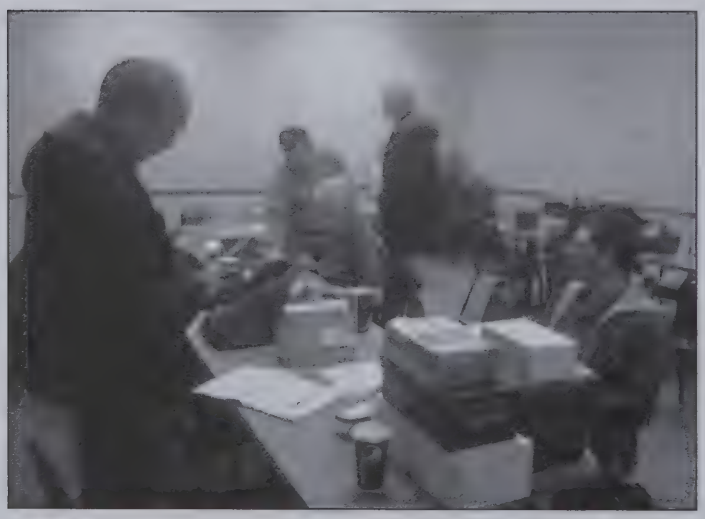


Figure 4—Midwest HomeBrewers and QRP group celebrated their 7th anniversary.

Figure 5—W9ZHC builds a regen receiver.

Figure 6—KØAWB's XYL finishes a keyer/speaker kit...

Figure 7—...and here is the finished product.

KØAWB, (Figure 6) finished her QRPKits,Buddy-Keyer/speaker console. She did a great job and man oh man is it pretty. (Figure 7) Dar nearly finished the HT kit, was missing one cap (had it at home) and will the mount it in case and tune it up on 27 MHz. if all is well, will order the 29 MHz Xtal and re-tune it for Ten Meter AM. If it works, then this will be an upcoming group build and there will be lots of us in the local area running QRP Ten Meter AM.

There was a group discussion about having a local area QRP net. Bands suggested were 6 Meters, 10 meters and 2 meters, maybe even an 80/40 meter CW net. Comments and thoughts to KØAWB@cox.net and/or W9HZC@cox.net.

Dar (W9HZC) is working on the prototype receiver for the 2012 OzarkCon Friday Night build. Progress is good, and fun!

That is all to report for now. Remember, our door is always open and the Pizza is always good, the second Saturday of each month from 11:00 AM until 2:00 PM or 3:00 PM or even 4:00 PM.

Check the web site for directions to Ashland, NE.

Pacific Northwest QRP Interest Group:

Rod Johnson, WE7X, sent in this summary of a recent meeting:

The P&C meeting of November 30, brought out at least fourteen interested folks. Various conversations were overheard regarding operating, building, and general ham chatter.

Lyle KK7P had a KX3 prototype with a couple of revisions. He mentioned a revised encoder and some newer circuit boards. Other secret updates are probably being withheld for later release.

Bob AD7BP showed a homebrew 10/15 meter loop he built from copper tubing, and has been used for several QRP contacts. Bruce N7RR talked about an upgrade class for those who are interested in upgrading to Extra class, which will be held in the Bellingham area in January or February. Although the class is targeted to the hams in the northern counties, others would not be turned away if there are still seats available.

Others present, whose call signs appeared on the log napkin, included: Charlie N7KN, Eldon WAØUWH, Bill WA7NCL, Doug W7RDP, Jeff K07N, Jack WA7KMR, John KC7NVE, Rick K7MW, Jim W7LS, and Rod WE7X

If I missed anyone, it was because your name did not get on the official napkin, and I was not observant enough to notice.

QRPadillos QRP Group:

Henry, W5HNS, and Mike, K5WNG, are working on some code classes—beginner ones for those who never learned CW and move up classes for those wanting to get their speed up to 18-20 wpm.

Everyone is still trying to locate locals so they can meet regularly. Any notice for anyone interested in low power work in the San Antonio area to contact Mike via the yahoo group would help.

4 State QRP Group:

In their Email reflector, a message was posted asking if there were people available who could help other handicapped hams in the 4SQRP Group by building their 4SQRP kits for them. A number of people responded and offer this as a free

Figure 8—The Peel Amateur Radio Club had two projects at their Buildathon: a crystal checker and a QRP bridge for a SWR/power meter. (Photo by VE3FAO)

service by donating their time, skill and knowledge. Their only motivation is to help needful hams. The only cost to the needful ham is the cost of the kit itself.

The webmaster, David Martin, K5DCM, devised an ingenious stop light method of indicating which builder was ready for a project. See the website www.4sqrp.com for details. Handiham's Pat Tice, WAØTDA, mentions the service on his weekly podcast, http://www.handiham.org/audio/handiham.m3u. Ed hare, W1RFI, noticed the listing in QRP-L and asked a staff member to call Terry Fletcher, WAØITP, for details, resulting in a mention on the ARRL blog, on their home page, and also the *ARRL Letter.*

If you have a group doing something like this, please let me know to get the word out there so everyone will know.

Peel Amateur Radio Club:

The Peel Amateur Radio Club's Semi-Annual Buildathon featured two separate projects. A crystal checker using a micro controller and a QRP bridge for the SWR/PWR meter featured in the spring Buildathon. Most of the participants built both projects.

An enthusiastic group of about 25 had fun all day building and testing the units. We had all age groups represented from pre-teens to Octogenarians. At our regular Homebrew Group meeting the following Tuesday we were able to test and calibrate any units that were completed at home over the weekend.

Other Notes

I received this note in an email and am putting it in here in an effort to hear more about motorcycle QRP groups. If your group fits, let me know about you and what you have been up to.

"Dwight DeWitt, WBØHBJ, motorcycle mobile in Eurekia, CA., he worked 60 meters and gave the QRP guys many contacts, myself included and that was QRP stations he was copying (Figures 9 & 10)! Now you have shown us goats, people gathered in fields and we are you what the 60 meter guys do and shortly KJ4OKC should have me photos of his totally self contained Appalachian Trail QRP/QRPp station he used, you have already been sent AK4JA's photos of his operation from Chesapeak Bay! The 60 meter QRP guys literally go every where to put that rare state and grid square on 60 meters. You need to put some of these photos in the *Quarterly* cause these guys get NOTHING out of this not even award credit except for the 1000/per watt award credit. They use sophisticated APRS, GPS to get it RIGHT and the only station that it helps is the station they are working, about time they got some credit for the great grid/rare state expeditions they do at their own expense, both financially and time wise. Larry K5ZRK # 6477"

Lastly, I want to mention the QRP ARCI Accessibility Challenge. One of the positive aspects about amateur radio is that it is accessible to many regardless of physical abilities or disabilities. Our club has members that have many different disabilities, but it does not prevent them from engaging in our hobby. Many of us enjoy building. There is a thrill in using a piece of equipment made with your own hands. Many believe it possible that our members, individuals or clubs, could create a kit that could be built by our visually impaired members. This is the QRP ARCI Accessibility Challenge and will be a special category in the FDIM 2012 building contest.

Until next time…

—72, Tim WB9NLZ

Figure 9—Dwight, WBØHBJ goes motocycle mobile on 60 meters, giving lots of QRPers a QSO.

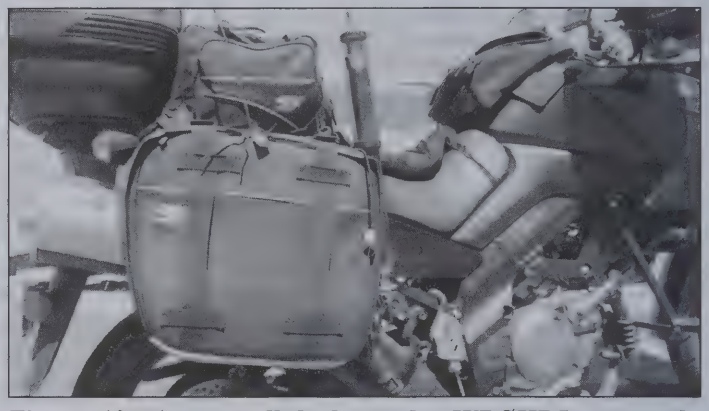


Figure 10—An overall look at the WBØHBJ motocycle mobile station (and vehicle).

QRP = Doing More With Less!

JABOM—A 17M SSB QRP Transceiver: Part 2

Pete Juliano—N6QW radioguy90@hotmail.com

This article is a continuation from Part 1, which was published in the Fall 2011 issue of QRP Quarterly. *We apologize for mis-numbering some figures in Part 1 (two Fig. 13s, two Fig. 16s, but none numbered 14 & 15). We hope that the captions made it possible to identify the correct figures. The figures in Part 2 are numbered to follow after those of Part 1.*

By now, I hope that you have had time to build the modules presented in Part 1 of this article comprising the receiver portion of our project. The receiver should be working well at this point and you should be itching to complete the transmit portion. Let's get to it!

Building the Transmitter Portion of the Transceiver

We will start with the TR Switching and Power Module. For TR Switching, I used a combination of relays and a solid state power-switching module that I actually designed myself. The switching module uses a 4N35 opto-coupler that is operated by the Push To Talk (PTT) Switch. The PTT action toggles a common 7400 IC to drive two PNP power transistors to an On or Off state. Thus the application of power to the various circuits that are powered On or Off in Receive and Transmit is done electronically. This reduces glitches and large switching transients. This circuit was first used in the 20M MMIC QRP SSB Transceiver. In keeping with one of our earlier stated goals, this is a simple matter of recycling circuit modules. There are two relays that form the actual signal routing in TR. The NO contacts of relay RY8 are ahead of the Transmit low level driver stages and the NO contacts of relay RY9 are on the output of the final amplifier, which allows connection to the Low Pass Filter (LPF) bank on transmit. In the Receive mode, these two relays enable connecting the LPF/Antenna directly to the Band Pass Filters. Figure 18 is the schematic of the power switching module and Figure 19 is a photo showing it installed in the transceiver. As a bonus this circuit also provides the capability to switch an external linear amplifier. Purists may shudder at the thought of operating at more than 5 watts, but having such a capability can come in handy at times if you don't have a QRO transceiver for the 17M band. Also, operation with an external transverter or other piece of separate equipment becomes much easier with a switching jack on the back panel of the transceiver. See Figure 26. The switch should not be used with relays that have more than 24 VDC applied nor have a current draw greater than about 50-60 mA. Using this transceiver with an unmodified vintage amp keying relay such as in the SB-200 will cook the 2N3904.

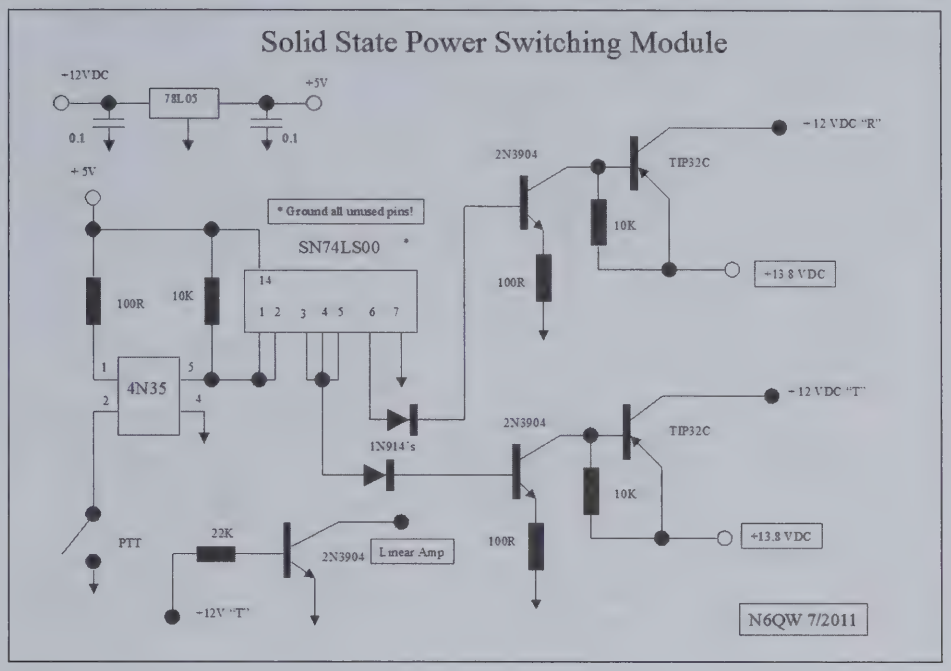


Figure 18—TR Power Switch schematic.

To check the operation of the power-switching module, start by connecting +12 VDC to the places so indicated in Figure 18. Don't forget to hook up the Ground lead. Place the + Probe of your handy DVM on the terminal marked +12 VDC "R". Without engaging the PTT, the output should indicate +12 VDC. Temporarily short to ground the terminal marked PTT and the voltage at this point should go to near Zero. With the PTT shorted move the + Probe over to the Terminal marked + 12 VDC "T" and it should now read +12 VDC. Remove the short and it should go to nearly zero. Pretty slick, huh?

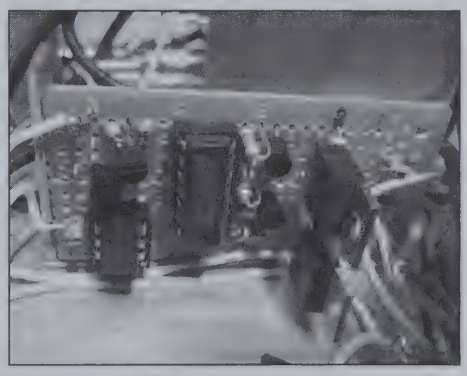


Figure 19—Photo of the Power Switch module.

Next we will build the Balanced Modulator, Microphone Amplifier and Tune Circuit. Figure 20 is the schematic and Figure 21 is a photo of the completed module. This module was built on a 1.5 x 2 inch piece of single sided copper vector board and a copper box enclosure is built around the assembly. The inputs to this module are the BFO/CIO signal and the audio input. These are circuits I have successfully used in the past and are easy to construct. This assembly has a microphone gain control via a small 50k trimpot. In operation, I set this trimpot near max gain. Ahead of this trimpot on the front panel is another gain control so that I am able to

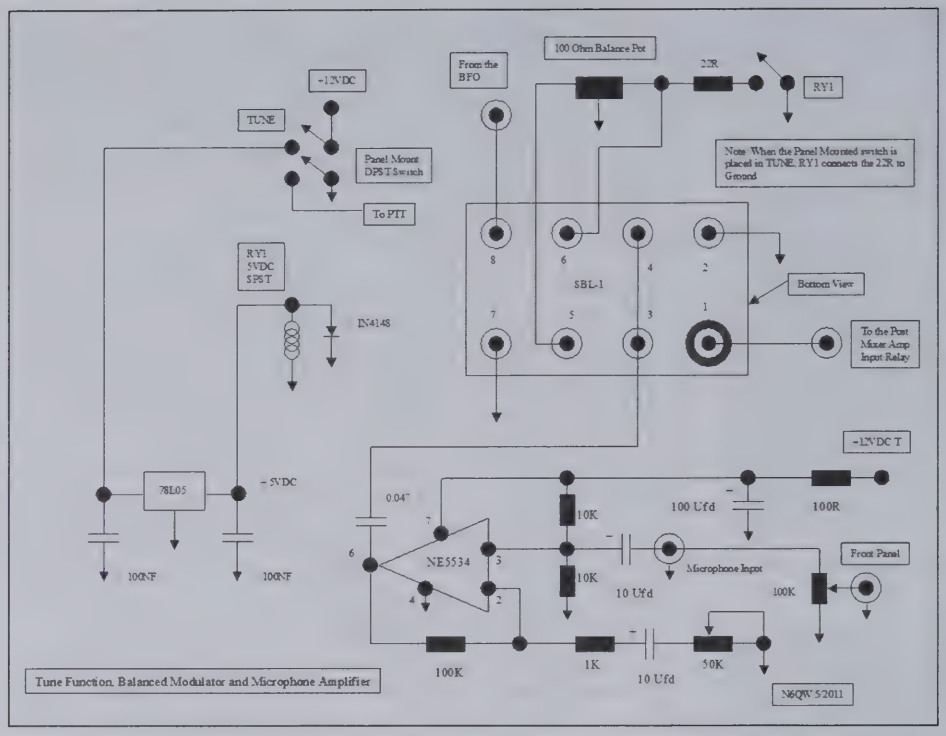


Figure 20—Balanced Modulator, Microphone Amplifier and Tune Up schematic.

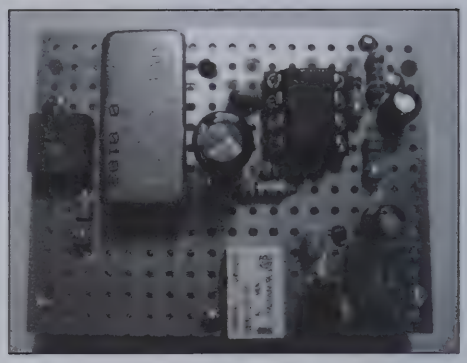


Figure 21—Photo of the module diagrammed in Fig. 20.

adjust the microphone gain from the front panel. I have several microphones that can be used with this radio and there is some adjustment needed depending on which microphone is being used. Many years ago I tried adding a manual balance control to the SBL-1 and was successful in doing so with the added bonus that this provides a means to unbalance the carrier for tune up purposes. This is the small 100-ohm trimpot that you can see next to the SBL-1 in Figure 21. The "Tune up" procedure is done with a panel mounted DPST toggle switch which controls a SPST relay in this module and simultaneously trips the PTT switch. The relay contacts unbalance the SBL-1. This works very well and beats feeding an audio tone into the microphone or shouting "HOLA" a million times into the microphone.

Now we are ready to test this module. The Microphone Amplifier is most readily tested with an Oscilloscope to visually experience that the unit is working. Don't have a 'scope? Not to worry as there are other ways to check for output. But before applying power, check to see that the NE5534 is placed correctly in its socket and that the wiring is correct and no solder bridges or shorts. When this module is complete and integrated into the circuitry you will have, in effect, a microwatt SSB transceiver—so we are getting close! If you are confident that the wiring is correct, then temporarily hook up 12 volts to the NE5534. Connect a headphone jack to the output at Pins 3 & 4 of the SBL-1 and finally a microphone to the input side at Pin 3 of the NE5534. Power up the circuit and listen for the signal in the headphones while tapping on the microphone to make a sound. Try adjusting the 50k trimpot to be assured that it is functioning. In the final installation, a panel mounted 100k pot is inserted into the loop and provides the level adjustment so that the Balanced Modulator is not driven into flat topping

If it passes these tests then we can connect the BFO/CIO to the SBL-1. Power on the BFO/CIO and, if a scope is available, look at the output from Pin 1 on the SBL-1. With the microphone connected but no sound input, adjust the 100- Ohm trimpot to one end of its range and observe the output. You should see a signal on the scope. As the trimpot is adjusted toward the middle of its range, you should see the signal diminish to zero and then reappear as you continue adjusting the trimpot. Set the trimpot at the point where the signal disappears. The mixer is now balanced and a pure DSB signal will be available at the mixer output. Next, temporarily connect a lead to the end of the 22-ohm resistor that is not connected to the SBL-1. Ground the other end of this lead and you will note there is an output. That my friend is a carrier, which is very useful for tune up purposes. Now, remove the ground and speak into the microphone. Observe that what is produced is a double sideband signal.

If you don't have a scope available, you can balance the carrier by tuning a general coverage receiver in CW/SSB mode to a frequency near the BFO/CIO frequency. With the 100-ohm trimpot near one end of its range, you should hear a steady tone. As you move through the trimpot range, the tone should diminish in amplitude, disappear at some point and then steadily increase in amplitude. Set the trimpot to the point where the signal disappears. Now, speak into the microphone and you should hear speech coming from the receiver. With a little retuning, it should sound like an AM signal.

Finally, set the 50k trimpot to almost max gain. Remove all of the temporary wiring, install this module on the breadboard and make the connections as shown in the schematic. In the final installation this module is directly behind the front panel so the microphone leads are short. This now completes the basic transceiver at a low level power stage.

Now let's do some testing with our microwatt SSB Transceiver. The objective of the following tests is to exercise the basic transceiver and to observe that everything is functioning, as it should. For these tests we will hook up the power module so that triggering the PTT will change over from Receive to Transmit and observe that all the interconnections work and the signals flow as they should. As you do the interconnections, it might be well that you have the transceiver block diagram handy.

For the Receive tests, the antenna can be connected to the Receive/Transmit Mixer stage. But for the transmit tests, it is wise to have a 50-ohm 1/4-watt resistor handy and connected to the mixer output. If you have access to an oscilloscope, clip the probe across the 50-ohm resistor. Close the PTT switch and speak into the microphone —you should see the typical "Christmas Tree" pattern. Without speaking but still having the PTT switch on, touch up the 100-ohm pot in the balanced modulator and look for a minimum carrier. Next, release the PTT switch and ground the 22 ohm resistor on the BFO/CIO module to place the transceiver in tune mode as before. Peak the Band Pass Filter Slugs for maximum signal. The trimpot in the emitter of the 2N2222A RF amplifier stage may need tweaking to increase the output. When you have the oscilloscope connected across the 50-ohm load, you should see something between 125 to 150 millivolts (mV). If you do the math at 150 mV, that is equivalent to 56 microwatts (μW).

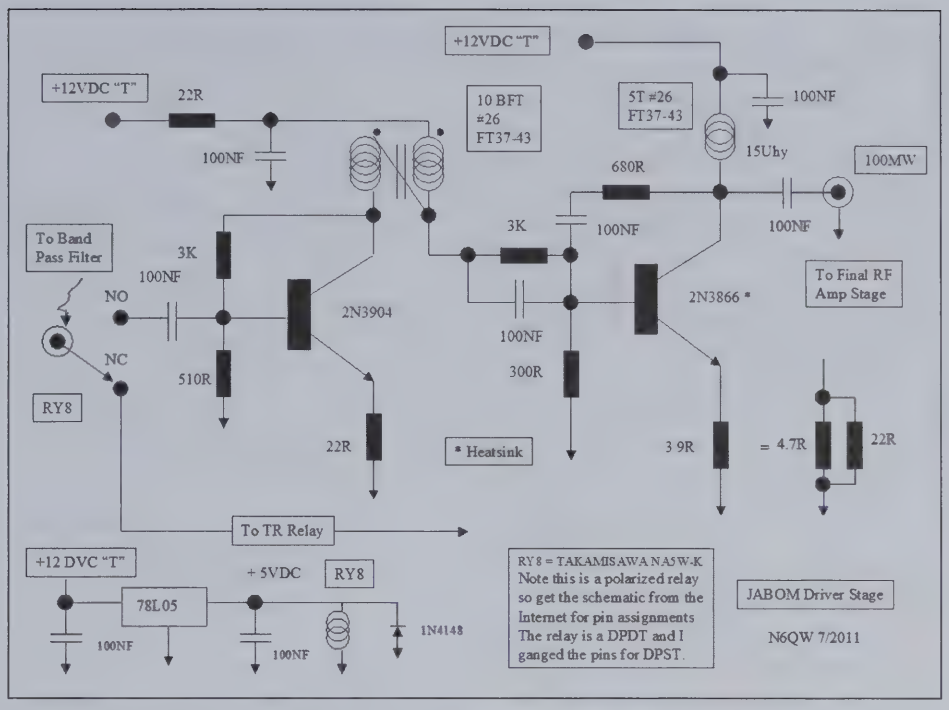


Figure 22—Schematic of the Low Level RF Driver stage.

If you don't have access to an oscilloscope, you can perform the same tests in the paragraph above by using a ham bands receiver in SSB/CW mode in place of the scope. Place a two foot wire from the receiver antenna connection near the transceiver and listen for the signal while the transceiver is in tune mode. When you hear the beat note from the transceiver, take the transceiver out of tune mode and close the PTT switch without talking. Adjust the 100 ohm trimpot to achieve the lowest amplitude signal or a minimum on the receiver S-meter. Again place the transceiver in tune mode and peak the signal output by tuning the Band Pass Filter slugs and the trimpot in the emitter of the 2N2222 RF amplifier stage.

If you try your mighty 56 μW signal on the air, be sure to build the 17M Low Pass Filter and have that in the line between the radio and the antenna. Let me know if you make any contacts running 56 μW.

We next turn our attention to boosting that 56 μW signal to the 5-watt level, which by the way is almost 50 dB of gain.

Moving on to the next module which is comprised of a low level driver stage taken right from EMRFD and consists of a 2N3904 driving a 2N3866. Figure 22 is the schematic of this stage where 100 mW of drive are easily obtained from this circuit. Likewise, when completed some may like to try making contacts using just this part of the module. You will need to have a final filter in place and at least two relays, one on the input and the other on the output, to enable TR switching.

Once the wiring is complete, run all of the usual tests such as wiring errors, solder bridges, shorted wires. By the way, in case you new homebrewers wonder if us old timers ever make errors like those listed above, the answer is an unqualified "Yes."

When I first wired this module, I installed the 2N3866 socket backwards so the emitter was where the collector was and the collector was where the emitter was. When I ran my tests, the output was really low. Since I had used this circuit many times, I knew I had a wiring error. Sure enough, but it was an easy swap of the socket and all then worked. Luckily, I didn't smoke the 2N3866. But I was tired and got in a hurry and didn't do a very good job of pre-checking. So what else would I expect when you don't follow the process? Trust me—take frequent breaks and check your work!

To test this stage, hook up the +12 VDC "T" voltage to this stage from the power-switching module. Temporarily connect a 50-ohm 1/2-watt resistor to the output of the stage. If a scope is available hang your probe across the resistor. If a scope is not available then take the RF probe built early on and after powering on the transceiver flip the tune switch to "Tune." If the scope reading is in excess of 6.32 volts p-p you have at least 100 mW or more. If you have previously calibrated the RF probe you should get a similar reading. You can also listen to a receiver tuned to 17M and observe the S-meter. Pull the 2N3904 from its socket, run the test and note the S-meter. Repeat the test with the 2N3904 and see if you get a higher S-meter reading. No, or a very small, output means employing the usual trouble shooting tests.

The 100 mW level is perfect for driving a commercial kit available from K5OOR (http://site.hfprojectsyahoo.com/home). The kit is called SDR 5W Amp and the cost with some pre-assembly is about $60. But, you will still need to build the LPF's. With that kit, 5 watts out is easily obtained with 100 mW of drive. Another kit available from Communications Concepts Inc will take that 100 mW and produce about 20 watts. The cost for that kit is slightly more than $100.

I chose to build my own final amplifier because I felt scratch building it was more in line with the objectives of the project. Figure 23 is the schematic for the final amp. This same stage was used in a prior project, the Tri-Band QRP SSB Transceiver built in 2009. The cost was

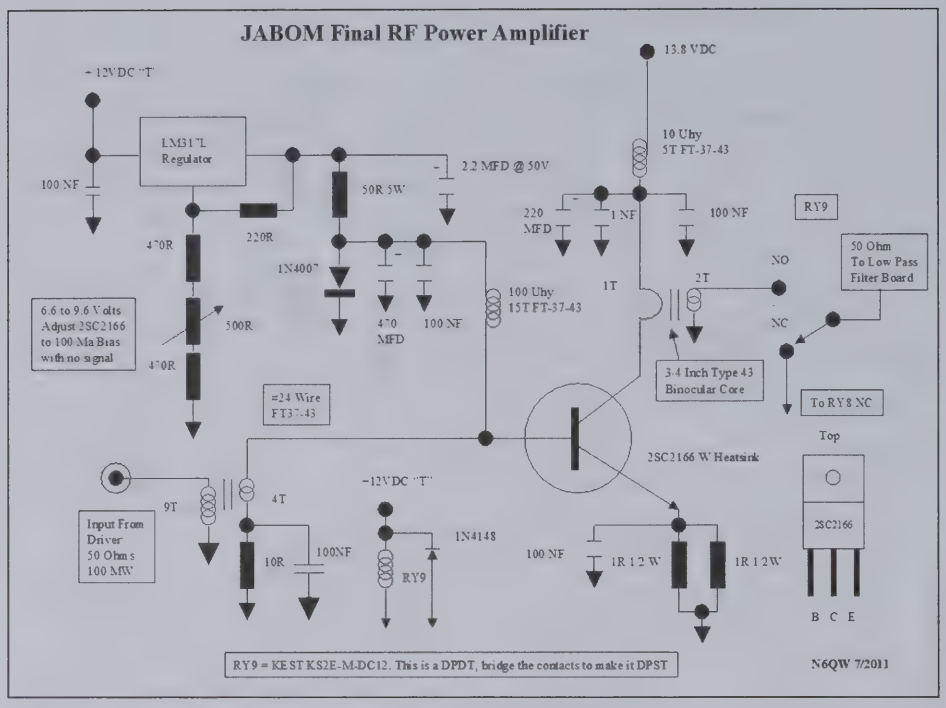


Figure 23—Schematic of the Final RF Amplifier stage.

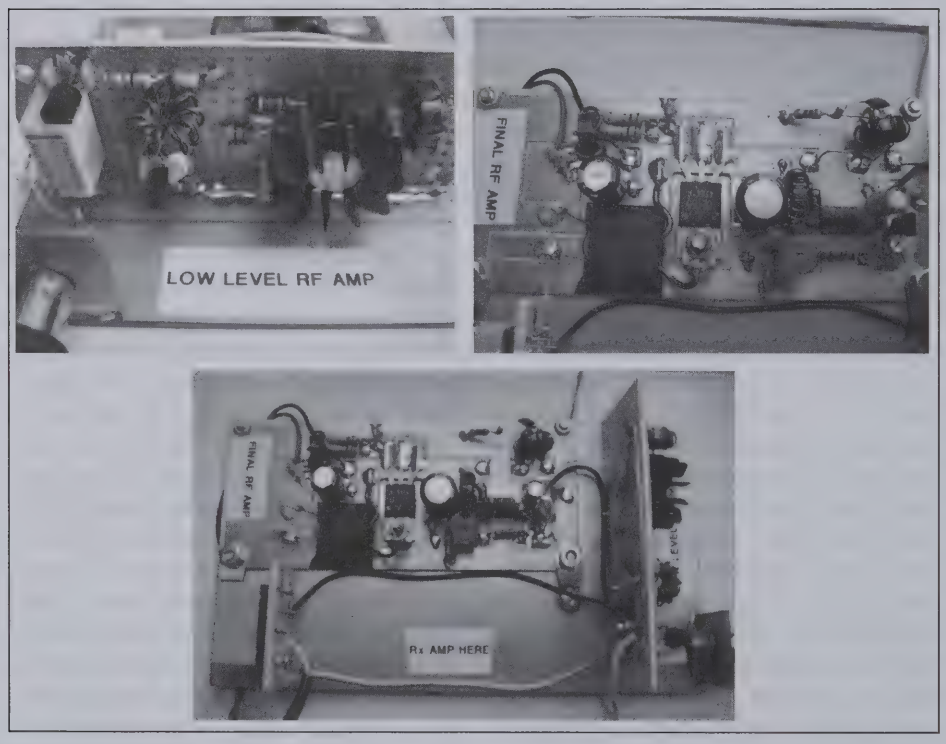


Figure 24—Photo of the three RF amplifier modules (see labels on each).

less than about $25 and the final device is a 2SC2166 available from RF Parts Inc. The prospective builder should also not overlook the possibility of liberating a final transistor from a defunct CB SSB transceiver. Watts is watts!

Figure 24 is a photo of the two stages and of special note is that there is physical space to add a Receiver RF Amplifier on this module if you desire. All that involves is to snip the wire in two that connects between the two relays, making the connections to your favorite RF amp stage and providing power to the RF Amp from the +12 VDC "R" line. I did not find that a Receiver RF amp was needed for 20 or 17M but may be some help on the higher frequency bands.

The 2SC2166 transistor requires a heat sink and this is where the double-sided copper board really shines. A cutout was made in the 2 x 4 inch single sided copper board that was larger than the outline of the 2SC2166. Using an insulated mounting kit and thermal grease, the 2 x 4 inch board was mounted to the larger double-sided board and a 4-40 hole drilled through the larger board and the transistor plus TO-220 insulator kit was installed and bolted down to the larger board. Then the four holes in the smaller board were drilled through and anchored with 4-40 nuts and bolts. In two of the corners, solder lugs were placed on the 4-40 bolts and then soldered to the larger board. This makes for a continuous ground plane and there is about 24 square inches of heat sink surface available for the 2CS2166. Copper is better than aluminum for dissipating the heat generated from the transistor. Cool, huh?

The test of this final stage has but one adjustment. But first, go through the process of checking for short circuits, solder bridges and wiring errors. Now to adjust the bias for this stage, our one adjustment. Temporarily connect a 0-500 DC mA meter between the power supply and the +12 VDC terminal on the 2SC2166. Key the PTT and note the current reading. Adjust the trimpot so that with no modulation the static current is 100 mA. That's it. Remove the meter and make a permanent connection to the amp stage. With no bias applied there is virtually no current flowing through the final amp. The Bias circuit is controlled by the +12 VDC "T" line.

The last module to be built is the Low Pass Filter (LPF) module. In my case, I simply bolted it to the back of the module that contains the Final RF Amplifier. Figure 25 is the schematic for the Low Pass Filter and this is simply a lift from the work of W3NQN, which appeared in a *QST* article. Data is given for the two bands of interest. I would suggest building and permanently installing the 17M LPF in the transceiver. If you want to operate on 20M, the LPF for that band can be hooked up externally and this approach would not require any special switches or relays. For those who have built the Soft Rock SDR kits, this is done with several of their kits.

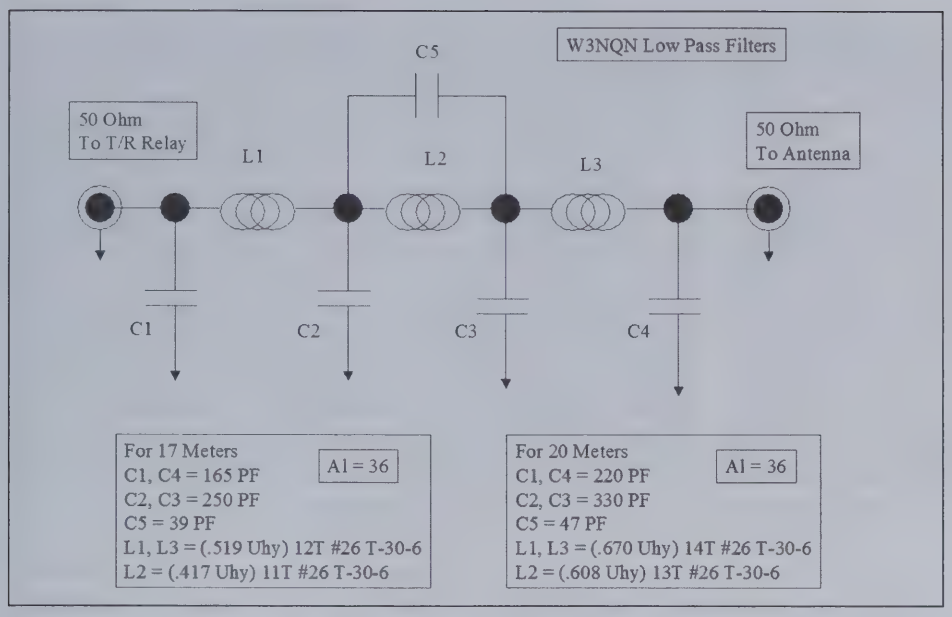


Figure 25—Schematic of the Low Pass Filter module.

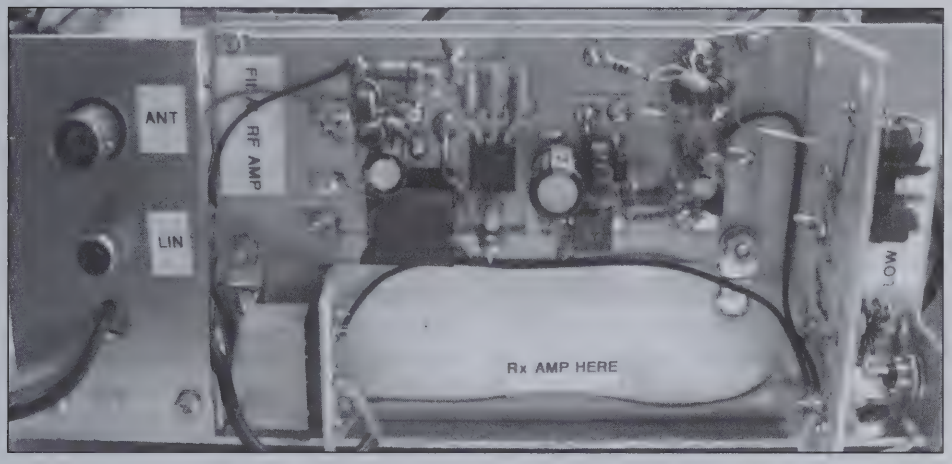


Figure 26—Rear-view photo of the transceiver..

The antenna connector is a BNC, in keeping with some of the semi-unofficial standards for QRP operators. I have not been very successful in installing BNC connectors on the ends of coax. So my answer is one of the commercial adapters to go from the BNC to RCA or SO-239. Thus the 20M external filter could be built into a copper box with a short length of RG-174-U terminated on both ends with RCA plugs with one connecting to the filter and the other to the BNC/RCA adapter. For the other connection on the output side, it is a builder's choice. Figure 26 is a photo of the rear of the complete transceiver.

Now with the radio hooked up to a dummy load and SWR bridge in-line, power up the radio, hit the PTT and speak into the microphone. If a scope is available, you can connect it across the dummy load and observe the Christmas tree pattern. Carefully look for any flat topping or excessive RF drive. Placing the radio into "Tune" should provide a substantial output. For five watts output, one should see about 44.5 volts p-p.

Early on, I advised use of the breadboard approach to hook up the modules. Now that the transceiver is completed and working, it is time to transition to something more permanent. In my case, I had a 8" x 10" piece of 1/16 inch thick aluminum and used that for the mounting base for all of the modules. I bought a piece of hobby aluminum that was 4 x 10 Inches and that is perfect for the front panel. Another option is a 12" x 12" piece of PCB for the base as that makes it easy to solder various connections to the base. Another possibility is to purchase a 8" x 10" aluminum chassis and mount everything on the top of the chassis. That approach certainly offers many opportunities and possibilities.

Now for the moment of truth, it is time to hook up an antenna to your radio. A couple of words about the antenna system - the antenna, especially when operating QRP, is a large hammer to facilitate making contacts. Take some time to evaluate your antenna as that is on the critical path to making this a successful project. Take a good hard look at the Moxon Beam, for example as this is a reasonable size for 17M and can be built with some common materials.

So what can one expect performance wise? I have used this radio both on 20 and 17M operating at the 5-watt output level. Contacts across the US have been made on both bands and of course I did work DX on 20M. If the K5BCQ frequency generator is installed then a two-band radio is a reality. The delta cost for the two bands (assuming you have purchased the K5BCQ frequency generator) is only about $10 in additional components. But I strongly suggest building the radio for 17M and use the VXO for the initial operation. The radio appears to be slightly more sensitive on 20M but that may be just a case of poor band conditions on 17M. Audio reports have been excellent and the most frequent comment I have heard is "amazing."

Author's Notes: This article is quite lengthy and still does not cover all of the possible questions or inquiries that readers may have. My website, www.jessystems.com, has a link that contains a complete parts list (with part numbers and sources) for this project. In addition, there is a complete set of schematics that can be downloaded and presented in a scale larger than what might be in the article. As also mentioned earlier, there is a tutorial on making the two styles of copper boxes and many photos that are not in the article, such as the S-meter module. My goal was to present a project that can be undertaken by those who are new to building more complex circuits such as an SSB transceiver and hopefully that end was achieved. I want to be certain there is more than enough information to make this a successful project!

—73s, Pete, N6QW

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PC Board Construction 101

Chuck Adams—K7QO chuck.adams.k7qo@gmail.com

This article will deal with PCBs and etching them using a technique called the Toner Transfer Method. It involves using a LASER printer and some simple techniques to create a printed circuit board. The chemicals used here are relatively dangerous and should be handled with extreme care. Use instructions and safety precautions recommended by the manufacturers at all times.

Why do PC board layouts and why use this technique? Using a commercial PC board house is expensive and can take too long. The USPS has made the process even longer to get delivery now and more expensive. Here are some reasons to try your own PCB projects using the techniques in this article:

- This method produces excellent results.
- This method produces a PC board cheaply.
- This method allows you to make a board in short order and correct mistakes in layout or in the project design.
- Single sided boards allow me to easily reuse parts again for any reason.

We can probably think of many more reasons for creating our own PCBs, starting with "it's fun."

Equipment and Materials Needed

First, let's assume that you already have a computer and a laser printer. I can only vouch for HP printers that I own and use. From your favorite discount store, you will need the following items:

- Set of plastic measuring cups starting with 1/4 cup.
- Clothes iron usually used for ironing clothes. Get the cheapest one at $7.00 with plain metallic ironing surface.
- Pyrex dish with 3 cup or 750 ml capacity with plastic/rubber snap-on cover, about four dollars. Get several.
- Rubber gloves, heavy duty and acid proof. About six bucks.
- Small plastic tongs for lifting board from harsh chemicals.
- Plastic spoons or forks for moving board around in harsh chemicals. Be extra careful using the spoons as they can launch chemicals out of the dish.
- Bottle of Hydrogen Peroxide in 32 oz size for a buck.
- Cheap can of clear enamel spray or krylon clear. Use the cheapest.
- Steel wool pads with the soap embedded. For a buck, you can get a package that has 15 pads in it.

From your nearby home center, you will need the following:

- Muriatic acid found in the swimming pool supply section. Two gallons for nine dollars. This stuff is about 16% acid by volume. We are going to dilute it by using 2-parts hydrogen peroxide to 1-part muriatic acid. Still, be sure to treat the chemicals with a great deal of respect.

From Staples (may be similar product from another office supply store) get:

- Staples color laser photo supreme photo paper (SKU 651611). For about twenty dollars you can get a package that contains 100 sheets. I have found this paper to generate the best boards but any slick paper should do the trick. You have to experiment to find what works best for you. I know that I did. Plain laser paper will not usually do a very good job.

From Ebay.com or other source:

- Go to ebay.com and do a search on the phrase "copper clad" and search down the hits for the printed circuit board material. I buy my boards from the vendor "abcfab" but there are others. The packages come via USPS priority mail and I have been very happy with the boards. With recent changes in USPS it may take more time now. And get there early after this article comes out. The resulting demand may greatly increase the pricing.

Note that there are two types of PC board substrate materials listed, CEM and FR-4. The CEM stands for Composite Epoxy Material and is not what you want, unless you want an excellent material for Manhattan Construction. I tried the CEM first and, although it works well, it has a paper center section that flakes somewhat. The FR-4 material is Flame Retardant and is the usual stuff that you think of for PCB material. I like the 060 thickness (0.060") and the 2 oz copper coating.

I purchased enough material to do 300 boards of size 3.25" by 3.0" for a total cost of $30.00 including shipping. So that amounts to $0.10 per board. These are double sided with 1 oz. copper plating with FR-4 laminate material. Sometimes you can find the single-sided board material from the same source and even different colors of material. Another use of the PCB material is in making cases for equipment and rigs.

Cutting the Board Material

This is an area in which you may have to experiment. I use a band saw for cutting larger size boards and a tile cutter to cut the material into the smaller sizes. Use all safety precautions in using any cutting tool. I wear gloves and a paint mask or respirator. Dust from the cuts is a safety hazard. Use a sanding block immediately after cutting to remove sharp edges along both top and bottom surfaces and the substrate. The copper shards are very dangerous and will do serious damage if you are not careful. I recommend wearing surgical or rubber gloves during and after cutting to reduce finger prints and to protect your fingers and hands.

I also have a small Harbor Freight shear that I use for sizing and cutting and it still hasn't dulled after years of use on PCB materials.

Cheap Etchant Fluid Mixture

The secret to etching PC boards is the combination of hydrogen Peroxide and muriatic acid. The oxygen in the peroxide oxidizes the copper and which then dissolves into the acidic solution. The proper ratio of the etching solution is 2:1 for 2 parts hydrogen peroxide to 1 part muriatic acid. Pour two 1/4 cups of hydrogen peroxide into the pyrex container. This is

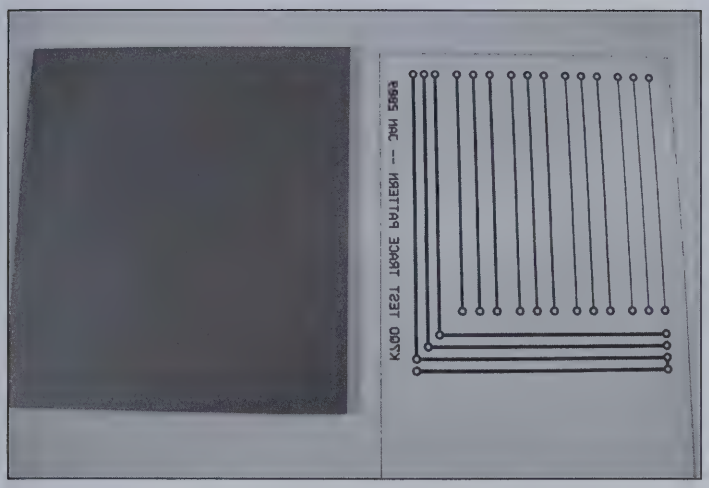

Figure 1—FR-4 board with printed test board layout.

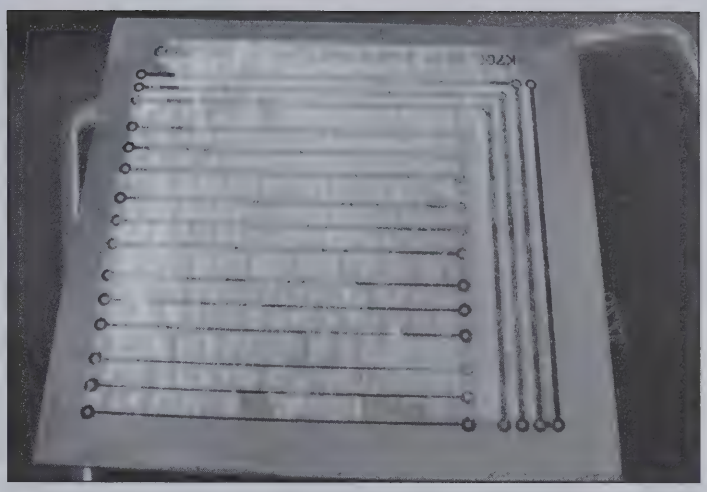

Figure 2—Test board with first pass at removing paper.

important. The peroxide goes into the pyrex container first. Then, slowly pour in one 1/4 cup of muriatic acid into the hydrogen peroxide that is in the dish. This mixture will do two 3.25" x 3.0" boards.

At $1 for the 32 oz bottle of hydrogen peroxide, that means I can do 32 batches of the etching combo from one bottle or about $0.10 per board. The muriatic acid was $4.50 per gallon or 64 batches of the peroxide and acid mix for about $0.15 or so per board for the etching solution.

I recommend that you only make up a 1/2 cup mix of hydrogen peroxide to 1/4 cup of muriatic acid mixture of the etchant to make a board at a time. The mixture will not hold its etching strength for very long. Keep the containers tightly capped for both chemicals. Store away from kids, pets and food.

Software

Here is a topic that will stir up a crowd more than the audience at a ZZ Top concert. I use expressPCB.com software on a computer with a Windows operating system. The software is not restricted in any way. It has schematic capture also and there is a learning curve as there is with all software.

First Steps for First Board

OK. We are now ready to try to create your first board. I would recommend trying the following experiment. Take the software and make a 3" by 3" area with nothing but straight parallel lines of different widths with a pad at each end. Start with 0.010" width and do a few of them followed by the next largest size, etc. Come back and put some pads at the ends of each line. Find the software interface to add text. Label some of the line widths and put your name, call letters and the date on the board also. After you have created a PCB layout, then print the layout to the recommended photo paper. Now you can begin the process of transferring the image to the PCB and then etching it for production of the final board.

Figure 1 is my test board layout with board to etch. Note that the text is reversed so that it will come out readable on the bottom of the board. The software does this automatically for the bottom copper plane of a two sided board. I have done only single sided boards, but you can also do double sided boards with some time and care. If there is some interest in doing this, we can do a second article on the issues and techniques for double sided boards. I find that I can do some complex layouts using only single sided boards.

Carefully place the laser printout PC board image on the board where you want it. Face down (with the toner in contact with the board surface). Carefully, using the iron in its hottest position and warmed up, iron the image onto the board. Some hints:

- No steam and lots of pressure, around 20 lbs or more, and just be careful not to break anything: the iron, the workbench or worktable.
- Put some blank paper under the board. I stuck the first one slightly to the workbench due to softened paint.
- Don't touch the board when you are done. Let it cool down without intervention. Can you say HOT? Don't do anything to speed this process as it will pop the toner from the board.
- Use the pointy end of the iron to apply pressure everywhere on the paper. Don't scrimp here, especially for the fine trace areas. Consider the process of ironing as exercise. Try to think about where all the traces are underneath the paper and apply lots of pressure for each area.
- Patience is the key. Be thorough and detailed. This makes a difference in how well your final board will turn out.

After the board has cooled, put very hot water in the Pyrex container and let the board and paper combo soak for about fifteen to thirty minutes. Come back and carefully peel the paper away from the board. Don't force it! I peel it from all four edges carefully. Don't touch the toner area. Handle board by the edges.

Figure 2 shows what you might see. Don't worry if it looks different. Don't try to get all the paper the first time. Just avoid pulling the toner traces off the board. You should not see any toner on the paper being pulled from the board, if you are doing this right. With the heat used to apply the toner to the board, there is a likely possibility that the board will darken and become oxidized. Don't worry about it. We are going to etch that part of the board away and no one but you is going to see it.

After you do the first paper removal, put the board back into some fresh HOT water and let it soak another fifteen minutes. Then lift the paper out and, using only the fingers and your skin, rub the rest of

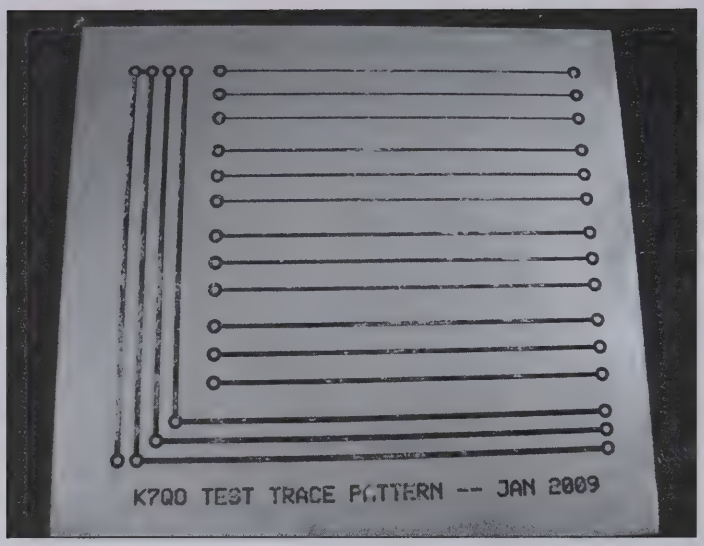

Figure 3—Test board with second pass at removing paper.

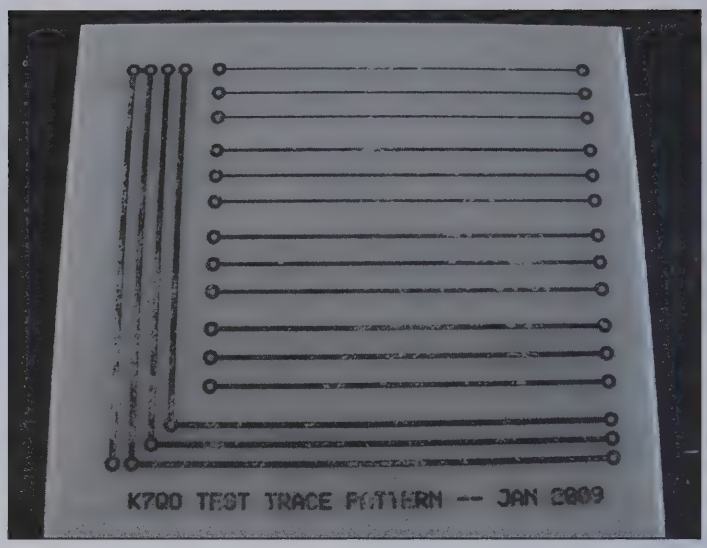

Figure 4—Etched board with toner still on copper laminate.

the paper off as much as possible. Don't use your fingernails or anything plastic or metallic. I perform this task under running luke-warm water from the faucet. It is not important that you get every bit of paper off the toner. It will look grey or white in some sections because the paper fibers are absorbed or stuck within the toner itself. Figure 3 shows the result of this process.

Now take the board and place it in the pyrex dish with the peroxide and muriatic acid mix. You'll know you are doing this correctly and the mix is right when the board starts to darken almost immediately. This is caused by the copper oxidizing. The clear liquid will also start to turn a light lime green in short order. I use two plastic spoons and GENTLY push the board back and forth in the mixture by the edges of the board, being extra careful not to touch the toner. Stay away from the fumes and stand upwind from any draft. Do this in a well ventilated area! Move the board around until all the copper is etched away from the board except the areas covered by the toner. Don't go off and leave the etching process as it could possibly ruin the board! After the board is completely etched, take the board out (using the tongs) of the solution and wash the board to stop the etching process. Figure 4 is what the traces look like up close when you have removed the board from the etching process and rinsed it. Dry the board with a clean paper towel.

WARNING: I know what some of you are already thinking. I can speed this up by heating the fluid. Don't. Please don't. You will create a dangerous situation and you will ruin the board by over-etching. Heating reduces the oxygen in the hydrogen peroxide rapidly and reduces the etching process. It is counterproductive IMHO.

After rinsing the board, I then use the steel wool with water to remove the toner. It is a cheap process that does not use hazardous chemicals and it removes some copper oxide from the copper surface.

Now the surface is exposed to the nasty atmosphere of the earth. I protect it by very very very lightly coating the surface with the cheap clear enamel from Wally*World. Do this in a clean, dust-free and well vented area also. Let it dry. I use a toaster oven at 120° F in the garage with a timer set for 30-45 minutes to cure the clear finish. This coating protects the surfaces and it also acts as a solder mask. Figure 5 shows the result.

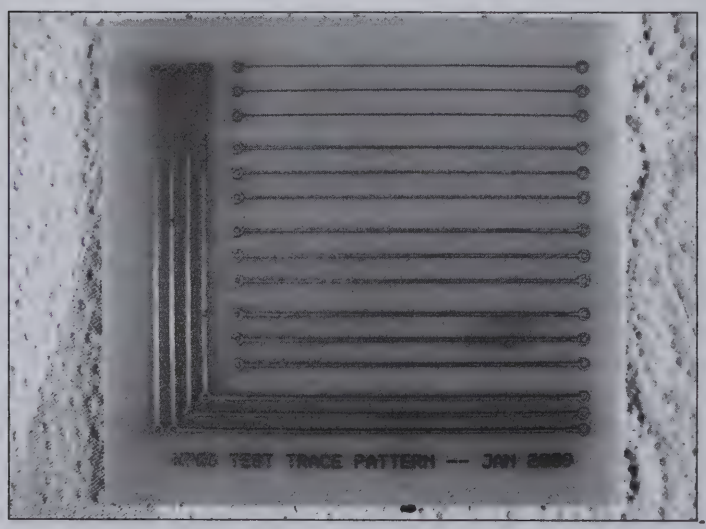

Figure 5—Board with copper layers cleaned and coated.

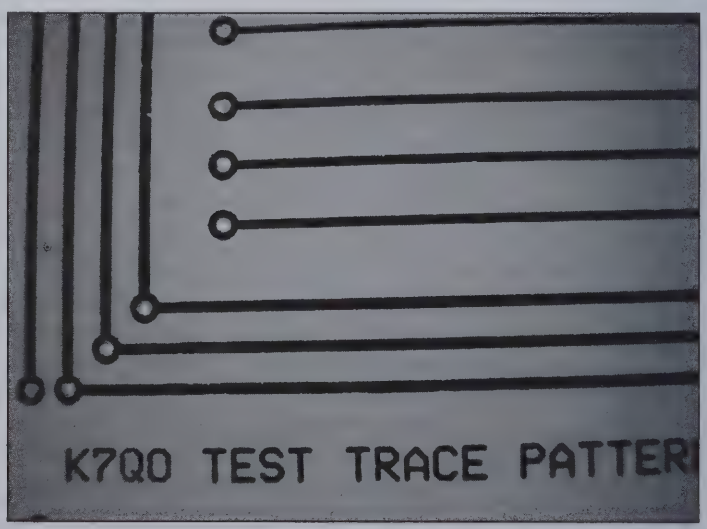

Figure 6—Backlit board showing drilled holes.

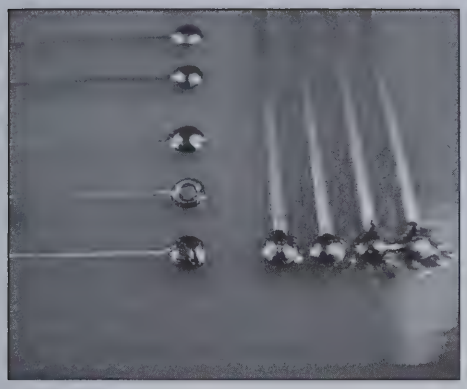

Figure 7—Backlit board showing soldered pads

Drilling Holes

I use a 0.70 mm carbide drill bit with a Dremel tool mounted in a Sears drill press for drilling holes at each pad. You have to have a drill press in order to drill the holes for parts mounting.

The drill bit is very, very small and easily damaged and will be if you do this by hand. I buy the cheap carbide bits from Harbor Freight.

Here's another trick that I came up with. Find a sewing-machine repair place. Ask them for a foot-pedal ($19) and electrical block (plug and socket combo for $13). By using the electrical block to power the Dremel, you can set the Dremel tool to high-speed use your foot (your hands are going to be busy) to turn the Dremel on and off easily. You can even vary the speed with the pedal. You might also try the power tool section at Harbor Freight as I found a similar foot pedal with outlet for less than $20 US.

I found that with the drill off, I can lower the drill and bit and almost exactly place it where to drill the hole. Then by using the pedal, I can start the drill and, while using one hand to hold the board in place and the other to work the drill press, I can do better work. This also reduces wear and tear on the on/off switch and speed control on the Dremel tool.

Figure 6 shows the board after drilling. It is being held up to the light to illustrate how well the holes are placed. You may have to experiment to find the pad sizes with proper hole diameter to match things up exactly. Or you can create your own pad configuration in most of the software.

Soldered Pads

Now take your soldering iron and some solder and solder the pads on your test board. This is to show you how easily you can solder through the clear coat of enamel paint.

Take your ohmmeter and measure the resistance of each of the traces.

You'll see that the wider traces have a slightly lower resistance and you can detect open traces. You might practice on a couple of different test patterns and boards to improve your techniques. See Figure 7 for the finished result.

Projects

I have attempted here to give you the steps necessary to make a PCB in a fairly safe and economical method. I hate the typical chemicals used for PCB manufacture such as ferric chloride and sodium persulfate. These are nasty and they are expensive.

I get the same results with the hydrogen peroxide and muratic acid mixture.

I have been using this method of creating and etching boards for many years now and just love the results. And I hope you do too. Start with simple boards. I suggest some simple test equipment like the G3UUR crystal parameter measurement oscillator and perhaps some fixtures for test equipment like the AADE meter. The future project list is unlimited.

Figure 8 is a photo of a Steve Weber, KD1JV, all discrete component (ADC) transceiver for 40 meters that he has on his web page. I am happy the way the project turned out and use it for show and tell to promote the PCB techniques in this article. *QRP Quarterly* and all the electronic books in the Universe have projects that you have wanted to try and now is your chance. I want to hear from you on any projects that you have done this way and feel free to contact me if you have any unanswered questions or details that I might have missed in this article. Create some new rig designs of your own and publish them here. The editors are standing by for your input. Time critical projects are awaiting your participation.

And finally, here in Figure 9 is a close up and personal SMT board that someone sent me an email to do. Note the blue lines from college lined notebook paper for sizing. The board etched nicely, so when I can no longer get PTH parts I'll be able to go to SMT at any time.

It is my sincere wish that this article helps those that are considering doing some work with PCBs. Enjoy and by all means be careful and safe.

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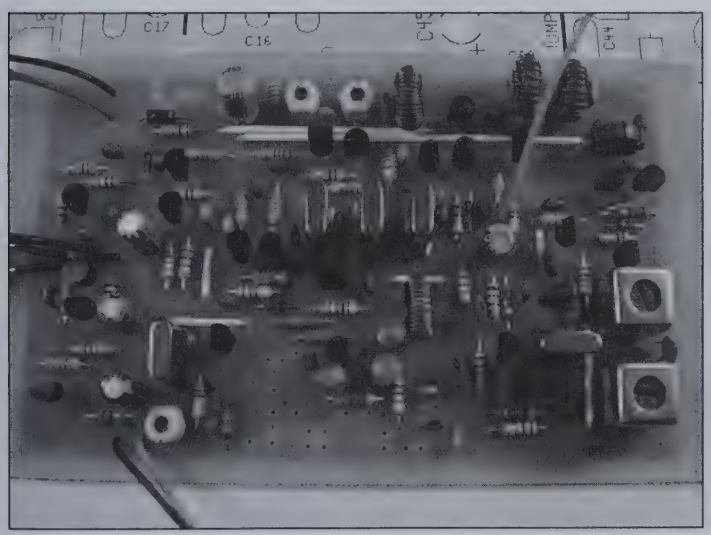

Figure 8—Almost done KD1JV ADC40 transceiver.

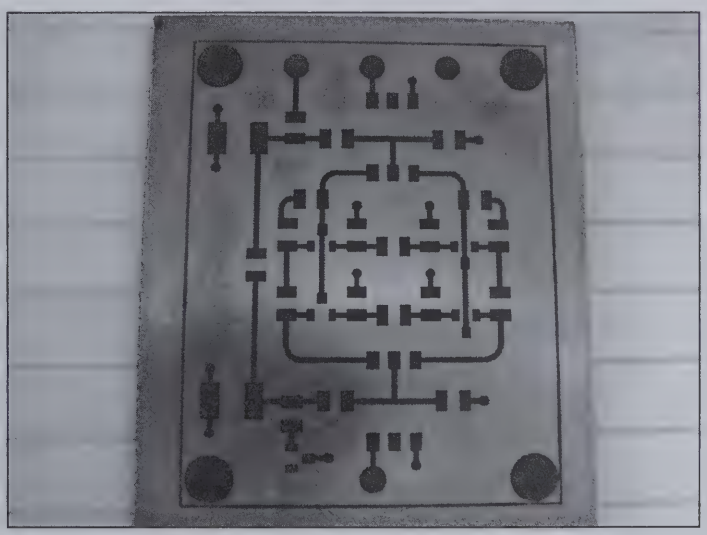

Figure 9—A small SMT board layout.

Antennas 101: Analyzing Unexpected Behavior

Gary Breed—K9AY k9ay@k9ay.com

Once in a while you build a new antenna or make a change to an existing antenna—and it works much better or much worse than expected. You check the construction and it's all OK. You really want to know what is going on. How do you figure it out?

Mainly, you try to find what you have overlooked. A few things I have experienced are:

- Change in height has more effect than I thought. For example, as you raise a low antenna above 1/4-wave height, the takeoff angle gets lower, improving performance at distance.

- Change in *effective* height. Inverted-vees and delta loops have a lower effective height than a straight dipole at the height of the top support. I've been disappointed with some loops that were installed without increasing the support height.

- Effects from the surrounding area. With all the "clutter" of an in-town location, I've seen unusually big improvements when an antenna is raised above rooftop level. Long ago I had a chimney-mounted 15M ground plane that was a great performer. At my present rural QTH, I discovered NOT to install low temporary dipoles near my shed with metal siding!

- Change in polarization. A dipole at a typical height near a half-wave uses ground reflection to enhance its gain. If a new antenna is sloped, it may not have the expected improvement since it has a weaker ground reflection. The exception is when the slope happens because you have only one support, and the sloper ends up a lot higher than you can install a straight dipole.

- You have been misled by modeling. Antenna software is a powerful tool, but it's easy to get results that are too optimistic, especially with vertical antennas. This subject could go on for pages; just be sure to read the program's instructions carefully to create an accurate representation of your antenna, ground and other nearby antennas.

Example: My 160M Vertical

I'm fortunate to have a 100-foot top-loaded vertical with 120 1/4-wave radials for the 160 meter band. My low band capabilities evolved into that system over several years, starting with a wire inverted-L and temporary radials laid on the ground over the winter season. As I made improvements—e.g., more height on the inverted-L and more radials—I tried to evaluate the amount of improvement.

First, the feedpoint impedance and VSWR bandwidth give some indication of the change. A lower impedance usually means that those extra radials have reduced the ground loss, which has its resistance in series with the antenna's own impedance. Lower ground losses also increase the antenna Q, which may make the antenna seem worse because the VSWR rises faster away from the "sweet spot" where it is well-matched.

Next, increasing the height of the vertical portion of an inverted-L increases the feedpoint impedance. Also, if you can slope the horizontal portion upwards, that will further increase the feed impedance. I hadn't realized this until I relocated my antenna slightly one year, which allowed me to run a support rope from one of the 70+ foot tall black locust trees on the property. My estimate is that the upward slope raised the resistive part of the impedance from 18 to 21 ohms—the higher impedance made matching easier, giving me a wider bandwidth without readjusting the match.

When I made the "big step up" to a vertical of tower sections, with a capacity hat plus lots of radials, my on-air assessment of the improvement was far greater than what computer modeling had led me to expect. This was a pleasant surprise, and I wanted to figure out all the reasons for the big improvement—maybe there is some information I can use to make future antennas work better! Here's what I came up with:

First, I had changed the feedline from RG-8 to some surplus 7/8" hardline I had acquired. At 275 feet, the difference in loss at 1.8 MHz seems small at about 0.5 dB, but that translates to a 12% increase in power!

Next, the feed impedance of the new vertical was about 45 ohms, much higher than the 18-21 ohms of the past inverted-Ls I had used. The resistance due to ground loss was now a much small portion of the total feedpoint impedance. This alone should have resulted in another 0.6 or 0.7 dB improvement.

I also had a much better radial system than what was used with the previous antennas. A "broadcast" type installation with 120 1/4-wave radials is supposed to have a loss resistance of 1 ohm or less. This probably made another 0.25 dB improvement.

The final factor is that the new vertical is installed slightly uphill from the past antennas, by about 6 feet. All radials are either level or sloped slightly downhill, whereas the previous inverted-Ls had about a fourth of the radials going uphill by the 6-foot difference in location. It's hard to make an estimate of the improvement, but it is certainly in the positive direction.

My best guess is that the sum of all improvements comes to roughly 1.5 dB, plus some additional help from the lower takeoff angle of a true vertical rather than an inverted-L. That's a 41% increase in radiated power—like going from 3.5 to 5 watts (or 1060 watts to 1500 watts).

Lessons Learned

1. Small Changes Matter. At first glance, 1.5 dB—1/4 of an S-unit—doesn't seem like much, but the on-air improvement was significant and unmistakable. Every dB (or fraction) counts!

2. Some Improvements are Easy. In this case, changing the coax alone was 1/3 of the total improvement. Going from RG-58 to RG-8x, or from RG-8x to RG-8 will have a similar result. On the higher bands, the difference is even larger.

3. Doing it Right Pays Off. Don't pay attention to my example of a giant 160M vertical—this lesson applies to a dipole in a tree, too! Make as few compromises as possible in height, orientation, feedline loss, installation in the clear, etc. When you pay attention to the details, the result will be more QSOs, longer ragchews, less QSB and all those other things we want when we get on the air! ●●

A Notebook QRP Station

Pete Ferrand—WB2QLL petef@sprynet.com

One of my goals in occasional picnic table/grass/beach operations is to spend the least possible time fussing and the most time on the air. (I do my fussing in private...) Generally my equipment consists of a transceiver, tuner, audio amplifier, batteries, key, paper, and headphones. All this stuff has to be removed from the carrying case, arranged in front of me, and plugged into each other. Not a big deal but it takes time, and didn't seem particularly elegant.

Some people build everything into one box, but that's a lot of work (is it worth it?) and mitigates against experimenting with new configurations. So, taking my cue from holiday assortments of chocolate and cheese, I came up with the idea of setting the gear into cavities cut into foam. Now, how to package it so it can be quickly accessed?

The simple answer was to take a three inch wide loose leaf ring binder, remove the mechanism, and hot glue the foam to the left inside cover. The paddle gets fitted to the upper left hand corner of the right side. This binder has a pocket on the right side for the notepad and cheat sheet. Just open the binder, hook up the antenna and headphones and you are QRV. And you can get away quickly when the storm starts. Figure 1 tells the story.

Figure 1—The notebook QRP station in operation.

It is worth taking some time to lay out where the equipment goes as you'll want sufficient space to maintain the strength of the foam between the cavities as well as any ergonomic considerations. My layout is shown in Figure 2. I created a cavity to clear the K9LU Bulldog key when the binder is closed. The Altoids tin in its original colors in the picture is used for spare band modules for the KD1JV designed ATS-3B. The switch next to the batteries puts the rig in either high or low power. The tuner is a homebrew version of the BLT. I used the smallest meter I had instead of an LED. It's housed in a Carlon electrical utility box. I've found these boxes extremely rugged, decent looking, and they cost a dollar or two at any home center.

It's important the binder close on something fairly sturdy. In my case it closes on the tuner terminals and the batteries. You could also put a dummy block of wood or similar into the foam if you don't want equipment to take the strain of having the binder close on it. You can probably do a lot better than I did by proper selection of the foam. As usual, I used what I had in the garage—foam insulating board from a project years ago. It took the hot glue without melting but that won't be true with all foams. Ideally I'd use a softer foam that grabs the gear better. Some of those will absorb water like a sponge, obviously not a great idea for outdoor electronics. You might try the kind of foam used in custom equipment cases. It's not real expensive but I've never played with it. It's readily available in a variety of weights and you can learn about it and the difference between open and closed cell foam, polyurethane and polyethylene, etc. on the Internet, and of course order it. A search for "case foam" or "foam case inserts" will get you started.

I used a made-in-USA Mead binder, 364-44NHB. I can't find that exact number listed among current product offerings but again, I used what I had around. Second hand stores such as Goodwill frequently carry this sort of thing if you want to save money. I carry the binder with the gear in a grocery bag made of nonwoven fabric. The finishing touch would be a label for the back of the binder saying, I guess, "QRP."

It sure is nice to be able to store the rig on a bookshelf instead of in a pile of little boxes!

—73, Pete

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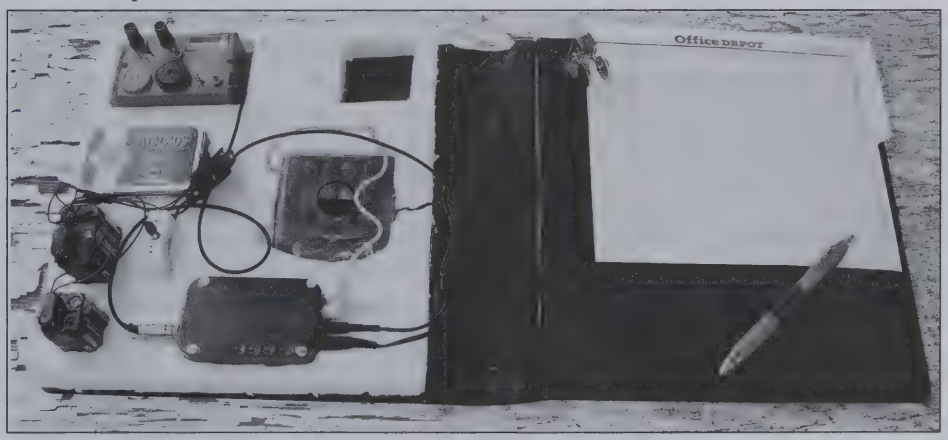

Figure 2—A close-up look at the notebook layout.

QRP Contests

Jim Rodenkirch—K9JWV

contest@qrparci.org

Mark Your Calendars!

HF Grid Square Sprint — 10 March 2012 — 1500z to 1800z

Spring QSO Party — 1200z, 7 April through 2359z, 8 April 2012
You may work a maximum of 24 hours of the 36 hour period

Hoot Owl Sprint — 27 May 2012 — 8 p.m. to Midnight Local Time

Well, somehow Jeff Hetherington and I started chatting just prior to when Jeff was considering giving up the duties as Contest Manager—I had mentioned months before that I'd be willing to volunteer some time to help him as needed; I figured his "free time" was being impacted by work and personal time commitments. After discussing what was all entailed and given my enjoyment at operating QRP, in and outside of contests, I offered to relieve him and Ken, W4DU, "OK'd" the transfer of the reins, so to speak. As I embark on my "tour" as Contest Manager, I pass on a huge thank you to Jeff for his work at managing the QRP ARCI contests over his time at the helm!

So, here I am with one contest, the Fall QSO Party, under my belt (the Top Band Sprint is over but the two week waiting period for log submittals won't be until after this write up needs to be in to the editor) as far as processing logs and figuring out who was tops in what category. Overall, I'm getting a sense for how to accomplish all of that smoothly, with a couple of changes and ideas popping up; more on that after an overview of the results for the 2011 Fall QSO Party.

2011 Fall QSO Party

First off, here are the participants with the highest scores in the various fall 2011 Fall QSO categories:

1) Bob Patten, N4BP, operating as K6JSS/4 with 2,204,048 points was far and away the top point getter in the All Band category (Bob seems to have a knack for accomplishing that each year, doesn't he?!?!?!).

2) The KnightLites Team, AB4PP, AA4XX, AE4IC, W4MY and W4MPS, operating under the call WQ4RP, took the honors in the Multi-op, one transmitter, category with a fine score of 633,688; someone posted a video of them operating during the contest, I believe it was on YouTube, and you can see that they had LOTS of fun, in addition to racking up a nice score.

3) Guru Jauregi, EA2IF, took top honors in the High Band category.

4) Carl Olson, WA3SEE, and Duane Demus, KA6AIL, netted equal top scores for Single Band, 10 Meters so there'll be two certificates handed out to those individuals.

5) Mike Tate, VA6FUN (like that call for some reason) earned a certificate for Single Band, 15 Meters.

6) Mike Blama, WA8SAN, was the winner in the Single Band, 20 Meter category.

7) Walter Thomas, K3ASW, was the top scorer for Single Band, 40 Meters.

8) Finally, the Aluminum Kings—K4BAI, K7RE, NØUR and N4BP (operating as K6JSS/4) took top honors in the Team category with an overall score of 4,202,744. Oh—yours truly garnered the highest score in the Low Band category.

Without doing a copy and paste of the bulk of the comments I can affirm that the vast majority of comments focused on the improved conditions for the higher bands. Some of the more notable comments include: "Fun to work our EA brethren on 15 and 20 meters"; "Good condx on 10 meters for EU contacts; "Excellent conditions. Great to hear DJ, F, I, JA and KH6 on 28.060—Too bad they couldn't hear my QRP replies"; and, "Great days are back and EA QSOs made the contest brighter."

We had 90 participants with several operators from Norway and Spain making up the European entries, a dozen or so Canadian participants and the rest scattered across the U.S.

Next up, in December are two events—the Top Band Sprint, slated for the evening of 1 December here in the U.S. (2 December time frame if going by GMT time periods) and the Holiday Spirits Homebrew Spring, scheduled for the 2000-2359z on December 18. In the next *QQ* I'll let you know the results of those two plus which ever contests are complete and scored prior to the next publishing deadline.

A couple of changes have been implemented and added to the appropriate contest announcements at the QRP ARCI web page. You're encouraged to take a few moments to visit the QRP ARCI web site and view the announcement and rules for each of the contests. First off, the summary information you provide that I need to score and check logs has been expanded so check the web site for the "new info" needed. The main reason for expanding the summary log info is to make it easier to score and check logs, particularly given the information requested is the data needed to calculate your score. A cautionary note: all of the summary logs submitted for the Fall QSO Party, no matter which logging program was used, had errors so, please, go over those logs, gather up the required information and submit those summary sheets. Second, contests/events where bonus point are awarded for homebrew equipment will see a slightly modified points award criteria; simply put, an Elecraft K3 no longer counts as "homebrew." The rules now state that equipment used by the participant must be, "built and soldered by you," so, anything "scratch built or from a kit is acceptable." However, "Plug and Play modular style kits (e.g., an Elecraft K-3) are not eligible for the bonus." Third, I had a friend redo the certificates—lots more color and "zip" to them. I'll ask Steve to post a copy of it so all can see it!

Aside note #1, related to future contests: In an effort to promote consistency, I've worked with our webmaster Steve, G4GXL, to restructure the format and wording for future contests. Additionally, all of the contest announcements for the remainder of 2011 and 2012 are complete and posted by Steve; we do not want you,

2011 QRP ARCI FALL QSO PARTY RESULTS

NAME	CALL	SPC	ENTRY CLASS	QSOs: Members	QSOs: Non-Members Diff. Continent	QSOs: Non-Members Same Continent	SPC TOTAL	POWER MULT	FINAL SCORE
Bob Patten	K6JSS/4	FL	AB	235	116	75	176	7	2204048
Brian Kassel	K7RE	SD	AB	178	27	38	127	7	954786
Brian Campbell	VE3MGY	ON	AB	132	5	53	94	10	738840
Jim Lageson	NØUR	MN	AB	144	16	28	111	7	652680
John Lainey	K4BAI	GA	AB	109	9	20	90	7	391230
Al Dawkins	KØFRP	CO	AB	109	6	41	70	7	318990
Larry Burchett	KCØM	MO	AB	97	5	22	83	7	318969
Paul Kirley	W8TM	OH	AB	91	12	21	80	7	305200
Bob Mackenzie	VC3ARCI	ON	AB	91	8	23	80	7	298480
Ed Dybowski	WD7Y	NV	AB	69	6	28	66	7	196350
Charles Fulp	K3WW	PA	AB	25	11.25	22.5	117	7	176085
Lawrence Maso	NU4B	TN	AB	65	12	8	63	7	171549
Ron Pettingill	N7RN	AZ	AB	53	3	9	54	7	111510
Joe Vrabel	KD2JC	NJ	AB	51	4	18	51	7	109599
Pat Byers	VE3EUR	ON	AB	54	5	10	49	7	106330
Don Younger	W2JEK	NJ	AB	52	5	12	49	7	104272
Mert Nellis	WØUFO	MN	AB	57	4	14	36	7	82908
John Thompson	K3MD	PA	AB	57	2	19	34	7	78778
Bill Cunningham	K4KSR	VA	AB	31	10	6	38	10	78660
Dave Larsen	N9ZXL	IL	AB	57	2	18	33	7	75999
Paul Beringer	NG7Z	WA	AB	34	2	8	53	7	71974
Mike	VE2TH	QC	AB	40	5	13	41	7	70602
Dave Reid	VE6BIR	AB	AB	44	2	6	42	7	70560
Bob Billingsby	KC9UR	IN	AB	44	2	6	41	7	68880
Jim Stoneback	K4AXF	VA	AB	54	3	8	32	7	66752
Steve Whitton	K9IS	WI	AB	36	7.5	4	40	7	61040
John Collins	KN1H	NH	AB	40	1	5	40	7	59920
Larry Card	W9CC	IN	AB	35	5	1	40	7	55160
George Tibbets	KF4UCC	VA	AB	36	2	7	34	7	48076
Charlie Blackburn	WX4CB	FL	AB	30	7	11	30	7	42000
Ray Cornelison	KJ4AOM	KY	AB	31	6	4	32	7	41888
Lee Hiers	AA4GA	GA	AB	32	6	8	24	7	33600
Bill Schmidt	WV1N	CT	AB	27	1	9	30	7	32970
Tom Dooley	K4TJD	GA	AB	28	3	3	28	7	30968
Hank Greeb	N8XX	MI	AB	25	2	5	25	7	25025
Eric Castro	VA3AMX	ON	AB	23	1	5	22	7	19866
"Mike" Michael	W3TS	PA	AB	18	1	4	13	10	13260
Jeff Hetherington	VA3JFF	ON	AB	15	1	0	16	10	12640
Daniel Arbogast	NØDA	OR	AB	22	2	1	16	7	12544
Sheldon Parker	K2MEN	NJ	AB	18	1	1	17	7	11424
Sandor Toth	NB1N	MA	AB	18	1	1	16	7	10752
Jim Fitton	W1FMR	NH	AB	13	4	2	16	7	9520
Jim Cluett	W1PID	NH	AB	10	6	2	16	7	8736
Scott McMullen	W5ESE	TX	AB	10	0	5	14	7	5880
Paul Gerhardt	K3PG	NY	AB	7.2	0	4	15	7	4620
Dan Birnbaum	AD6JY	CA	AB	12	0	1	10	7	4340
Rem ODonnelley	K6BBQ	CA	AB	7	0	5	9	7	2835
Jerry Metz	N1Qll	ON	AB	6	0	1	6	10	1920
The KnightLites QRP Association (AB4PP, AA4XX, AE4IC, W4MY, W4MPS, N3GO):									
	WQ4RP	NC	Multi/1	134	20	52	106	7	633668
	K4AEN	VA	Multi/1	39	6	11	43	7	72541
Joe White	WA4GIR	NC	Multi/1	29	4	7	26	7	31850

Results listing continued on the following page...

2011 QRP ARCI FALL QSO PARTY RESULTS (continued)

NAME	CALL	SPC	ENTRY CLASS	QSOs: Members	QSOs: Non-Members Diff. Continent	QSOs: Non-Members Same Continent	SPC TOTAL	POWER MULT	FINAL SCORE
Guru Jauregi	EA2IF	EA	HB	144	33	17	109	7	676018
Jorge Accunzi	EA2LU	EA	HB	114	20	12	87	7	410466
Alfonso Galardo	EA4CWN	EA	HB	88	10	8	64	7	222208
Pete Hardie	CG5VA	SK	HB	53	6	6	52	10	156520
Agustin Rodriguez	EA2AZ	EA	HB	58	5	10	55	7	127050
Mike Baker	K7DD	AZ	HB	45	2	6	41	7	70315
Will Bowser	K9FO	IL	HB	38	7	7	38	7	61712
Craig Behrens	NM4T	AL	HB	43	0	11	34	7	56406
Terry Young	K4KJP	AL	HB	25	1	9	28	7	28812
Chuck Stroud	KA8HDE	MN	HB	27	2	1	25	7	25375
Bill Burrows	WA7NCL	WA	HB	26	1	3	25	7	24500
Ron Silvia	WB1HGA	MA	HB	22	1	5	24	7	20832
Johann	ON6MS	ON	HB	21	9	3	20	7	20580
Randy Jones	K8FZJ	RI	HB	16	1	1	17	10	14620
Ted Albert	AB8FJ	OH	HB	12	2	2	15	7	7560
Ken Norman	VE7KBN	BC	HB	15	0		14	7	7350
Harold Slack	VE5BCS	SK	HB	11	3	2	12	7	5964
Ricardo Navarrete	EA4ZK	EA	HB	5	5	6	9	7	3591
Ade Weiss	WØRSP	AZ	HB	8	0	3	10	7	3220
Aage Grøseth	LA1ENA	LA	HB	7	0	4	6	7	1806
Arthur Jackson	KA5DWI	TX	HB	7	0	0	7	7	1715
John Midgley	G3SAO	G	HB	3	0	3	4	7	588
Jon Hellan	LA4RT	LA	HB	0	1	0	1	7	28
Jim Rodenkirch	K9JWV	UT	LB	34	0	9	32	7	42112
Kris Merschrod	KM2KM	NY	LB	15	1	24	18	7	16002
John Egger	K3GHH	MD	LB	15	0	0	12	7	6300
Carl Olson	WA3SEE	MD	SB-10	4	1	0	4	7	672
Duane Demus	KA6AIL	CA	SB-10	4	0	2	4	7	672
Javier Oviedo	EA2BVV	EA	SB-10	1	0		1	7	35
Mike Tate	VA6FUN	AB	SB-15	22	2	4	22	7	19404
John Watkins	NØEVH/M	KS	SB-15	10	0	1	10	7	3640
Dave Burnett	WD8KRV	AZ	SB-15	3	0	1	4	7	476
Mike Blama	WA8SAN		SB-20	17	0	1	15	7	9135
Grerg Mulder	WB8LZG	MI	SB-20	13	0	2	14	7	6762
John Nelson	K5FSE	GA	SB-20	1	0	6	3	7	357
Bob Cutter	KH6/KIØG	HI	SB-20	0	2	2	4	7	336
Walter Thomsas	K3ASW	MD	SB-40	21	2	3	22	7	18326
John Jolly	WA7NWL	AZ	SB-40	7	0	1	7	10	2590
Aluminum Kings: K4BAI; K7RE; N0UR; K6JSS/4 (N4BP op.):									
			Team	3330	672	322	504	7	4202744
MONteam: EA2AZ; EA4ZK; EA2LU; EA2BVV; EA4CWN; EA2IF:									
			Team	2050	292	106	325	7	1439368
JT Ham Camp	K5FSE; K4TJD:								
			Team	145	12	18	31	7	31325

the participants, to have to wait for a period of time just prior to a specific contest to review specific contest announcements!

Aside note #2: I was able to keep up with the received logs and summary sheets for Fall QSO Party enough that at the end of the two week window for log submittals I had the scoring completed and was able to pass on to Steve, G4GXL, the highlights of the contests. I believe Steve had the results, in spreadsheet form, posted within one week of the last day for log submittals. If all goes well, the posting of results within a week of the last day for log and summary sheet submittals, will be the norm for future contests.

Finally, Jeff Hetherington passed on some of the participant data associated with each contest. If one looks at the "numbers," one doesn't see the participant count one would expect for these contests! For the 2011 Fall QSO Party we're looking at around 3% participation (90 logs submitted) by subscribing members; note that the average for the Fall QSO Party is 115, prior to this year. Given there are >14,000 QRP ARCI numbers assigned and around

2,500 paid members/subscribers one would like to think that more than 90 participants could be counted on to show up. A small group of staff and Board members have been looking into putting together a survey that you, the members, would be able to participate in that would assist us in reaching our ultimate goal—establish QRP ARCI as THE premier QRP-supportive organization by using the survey results to promote more contest participation in QRP ARCI-sponsored contests. The focus of the survey will be on: a) Discovering what drives QRP ARCI members and non-QRP ARCI members to participate in contests and b) Unearthing what turns members and non-members off about our contests. I'm planning on working through the basics of this survey effort over the coming month or so with the "survey savvy" people that have offered to help and then we'll be soliciting your input(s); I believe that the QRP ARCI organization should be "leading the show" as far as promoting more QRP operations and your support with completing this survey will go a long ways towards achieving that goal.

I'm not interested in killing trees in order to list all of the upcoming contests/events so I encourage you to go to the web site and look for the QRP ARCI Contests button on the left hand side of the home page. Click on that button to find all of the information needed to participate successfully. If you have specific questions please e-mail me at contest@qrparci.org.

In an aside note sort of way, I did some digging around on recent major contests and found some of our QRP members doing quite well. During the 2011 Field Day event, W3TS (ARCI #3315), K5WNH (ARCI #4873) and N8BB (ARCI #10638) finished in the top five for the 1B1B category; a hearty well done!

Also, of note: for the 2011 ARRL DX contest, Single Op QRP category three of our members finished in the top five; K3PH (ARCI #11318) finished first!; VA3DF (ARCI # 11706) finished second and N1TM (ARCI #4350) finished fifth - a big well done to them as well!

I look forward to hearing and working you during and outside of the upcoming events in 2012. As Jeff Hetherington use to sign—keep your power down and QSO rate(s) up!

—72, Jim Rodenkirch, K9JWV

2012 QRP-ARCI Contest Schedule

Pet Rock Sprint Celebration
7 January 2012
1500Z to 1800Z

Winter Fireside SSB Sprint
29 January 2012
2000Z to 2359Z

HF Grid Square Sprint
10 March 2012
1500Z to 1800Z

Spring QSO Party
7 & 8 April 2012
1200Z on 7 April 2012 through 2359Z on 8 April 2012.

Hoot Owl Sprint
27 May 2012
8pm to Midnight LOCAL TIME

QRP Shootout
16 & 17 June 2012
CW: 1500Z to 2100Z on 16 June
SSB: 1500Z to 2100Z on 17 June

Summer Homebrew Sprint
8 July 2012
2000Z to 2359Z

Welcome to QRP
25 August 2012
1500Z to 1800Z

The Two Side Bands Sprint
USB (10m, 15m, 20m) and LSB (40m, 80m)
8 & 9 September 2012
USB: 1500Z to 2100Z on 8 September, and 1500Z to 2100Z on 9 September
LSB: 2100Z on 8 September to 0300Z on 9 September, and 2100Z on 9 September to 0300Z on 10 September

Fall QSO Party
13 & 14 October 2012
1200Z on 13 October 2012 through 2400Z on 14 October 2012.

Top Band Sprint
29 November 2012
0000Z to 0600Z
Note, this is the evening of 28 November 2012 in North America

Holiday Spirits Homebrew Sprint
16 December 2012
2000Z to 2359Z

See **www.qrparci.org** for rules and additional information

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Wooden plaque with your callsign, on 7" × 7" hardwood.

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Generous-sized coffee mug with the club logo on both sides. The mug is gray with printing in blue.

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While supplies last—1996-2005 ..... $7
How to Achieve 20 WPM CW With No Effort on Your Part,
or, *I'm Lazy and Don't Want to Work at it*, by Ron Stark, KU7Y $6

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- ***Add $5 for DX outside North America***

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Pay-Pal to ToyStore@qrparci.org
Find us on the web at www.qrparci.org

FDIM
Four Days in May
May 17—20, 2012

Thursday a full day of Seminars

Friday spend some time with vendors

Friday daytime, take a break or attend Hamvention

Wednesday evening Registration and get together

Friday Evening Vendor Night Judged Competition Home Brew Displays

Guest/Spouse Program

- Registration and getting acquainted begins Wednesday evening.
- Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell and plenty of time to swap tales during the evening. We have some special activities planned for Thursday afternoon.
- Friday daytime is open to attend the Hamvention® and visit the QRP- ARCI Toy Store. The hotel will supply some gathering space.
- Friday afternoon and evening activities usually include "show and tell", vendor displays and a judged home brew contest.
- Saturday is again open for the Hamvention. For the evening, and we have our great annual banquet, awards presentations and door prizes.
- Sunday is the Hamvention®, and check- out.

FDIM Registration and Hotel Reservation on www.fdim.qrparci.org

Home Brew Contest	Door Prizes
Special Activites	Discounted Hotel Rooms
Banquet	Complimentary Breakfast
Seminars	Hamvention just across town
Meet the Speakers	Nearby Restaurants
Vendor Displays	New Product Announcements
Discounted QRP Products	Spouse Program

Saturday Evening Awards Banquet Door Prizes

Thursday Evening Meet the Speakers

Thursday Evening Casual Show and Tell

Thursday Afternoon TBD

Saturday Morning Off to Hamvention or see the sights

Much More! Watch the web site www.qrparci.org

This is preliminary information. Some changes will most definitely occur.
Please check the web site, www.qrparci.org, for the latest details and registration information.

12.14.2011

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http://www.qrparci.org/us2signup.html

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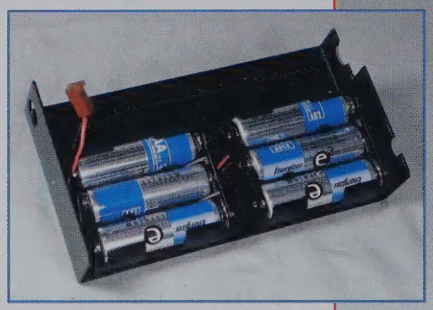

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